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Honorary Secretary and Curator.

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The Essex Field Club is intended to band together those taking an interest in Natural Science residing within or near the borders of Essex, as well as those in London, with the aim of creating and fostering a taste for the study of Nature in the field as well as in the study.

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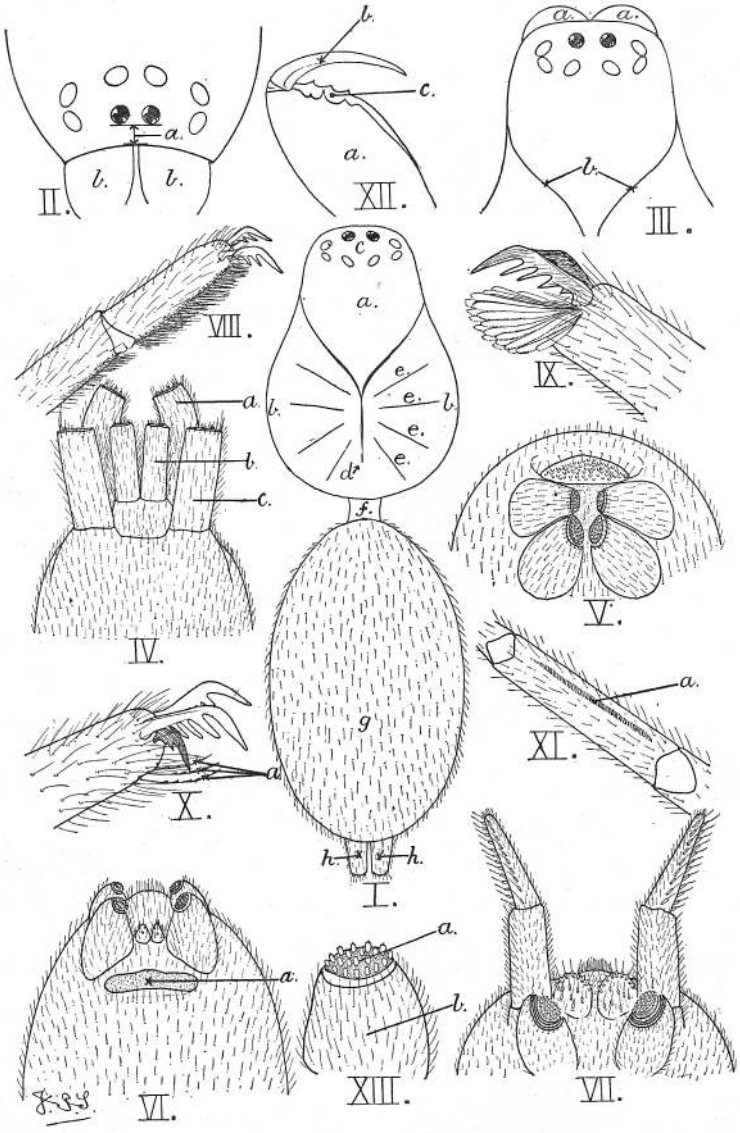


DISSECTIONS OF TYPICAL SPIDERS *(For explanations see text.)*

THE SPIDERS OF EPPING FOREST.

By FRANK P. SMITH.

Part I.

Influenced by the memories of many pleasant days spent within the leafy glades and upon the sunny heaths of Epping Forest, it is with something like a sense of duty that I enter upon the task of compiling a descriptive list of the spiders indigenous to this lovely district. I need in no wise eulogise upon the natural beauties of the Forest, for they must be familiar to every resident in the northern portion of the Metropolis, and, for the benefit of the stranger, we have more than one good guide-book dealing with the attractions of the neighbourhood. We constantly hear it remarked that for certain groups of insects the Forest is not so remunerative a locality as it used to be; but we must admit that it would be an absolute impossibility for a well-studied order, such, for example, as the Lepidoptera, to hold its own in a collecting ground within so short a distance of the Metropolis. In many parts of the Forest, too, the London-clay, with its somewhat limited flora, comes to the surface, thus tending to decrease the variety of insect life in those localities. To-day, however, in spite of the attentions of energetic collectors and the depredations of thoughtless excursionists, this district may be relied upon to furnish treasures innumerable for the earnest student of nature who is willing to enter upon the task of investigating those orders of the animal kingdom which have been for one reason or another more or less neglected. Foremost amongst these must be placed the ARANEAE, or SPIDERS, with which I wish to deal in the present series of papers. The list of species as it now stands, although in many respects a good one, will no doubt be materially augmented by further search, and it is hoped that these notes may not be regarded as "something attempted, something done," but rather as an incentive to the enterprising collector to avail himself of every opportunity of gathering specimens of spiders in this interesting locality.[1] I am confident that one of the greatest obstacles to the advancement of British Araneology is the lack of up-to-date literature in the

1 The previous papers on Spiders in our publications are only two in number, viz.: "A contribution towards a knowledge of the Arachnida of Epping Forest" by the Rev. O. Pickard-Cambridge (*Trans. E. F. Club. Vol. iv.*, pp. 41-49) and "Further contributions" on the same subject, by F. O. Pickard-Cambridge, ESSEX NAT., vol. xi., pp. 315-318. ED.

English language. True it is that the study can boast of abundance of valuable embellishments bestowed by such well-known scientists as Mr. F. O. Pickard-Cambridge, the Rev. John Hull, Dr. G. Carpenter, etc., but the foundations laid in this country by the untiring industry of Mr. John Blackwall and the Rev. O. Pickard-Cambridge can hardly be expected to support the rapidly-increasing structure of araneological science superimposed by a few earnest students of this much-neglected order. A practical difficulty, too, presents itself in the scarcity of copies of Mr. Blackwall's *Spiders of Great Britain and Ireland* and the Rev. O. Pickard-Cambridge's *Spiders of Dorset*, and in the face of such facts I may be allowed, perhaps, to add my iota to the splendid efforts of these veteran araneologists.

In the hope of affording assistance to prospective students of the order I feel justified in devoting a considerable portion of the space at my disposal to the consideration of the anatomy and classification of the Araneae, trusting that opportunities will arise later for the publication of more detailed generic and specific descriptions. It will be obviously impossible to publish full drawings of all the species enumerated, but I hope to illustrate many of the more important specific distinctions, by means of which the collector will be enabled to recognise at least the commoner and more striking of the Epping Forest Spiders. I find from experience that simple, diagrammatic drawings are of far greater practical value than heavily shaded productions of a more pretentious character, and I propose to model the present illustrations in accordance with this belief. In generic and specific descriptions, similarly, style and effect must be sacrificed to clearness, even at the risk of frequent iteration and monotony of expression.

In order to facilitate reference the subject matter might, I think with advantage, be arranged as follows :—

I. *Anatomy*, including description of anatomical terms.

II. *Classification*.

III. *Practical Work*, including collection, examination, and preservation of specimens and noting of habits.

IV. *Literature*.

V. *A Systematic List of the Spiders of Epping Forest*, including brief descriptions of families, genera and species.

I.—*ANATOMY.*[2]

Body. The body or trunk consists of two well-defined parts, *Cephalo-thorax* and *Abdomen*, connected by a slender *Pedicle* or waist.

Cephalo-thorax. This is the anterior great division of the body, consisting of the *Caput* or head, and the *Thorax*. These two parts are fused together, a more or less distinct linear impression usually indicating the junction. Traces of original segmentation of the thorax are as a rule apparent in the form of depressed lines termed *lateral impressions* which converge upon a more or less distinct *central impression* (occasionally absent). The integument of the cephalo-thorax is of a more or less firm and resistant character; but in the case of some species in which the abdomen is protuberant anteriorly, the posterior portion of the thoracic integument becomes of a somewhat pliant nature. The caput is more or less wedge-shaped posteriorly. Upon the posterior portion of the upper surface of the thorax is occasionally found a stridulating organ The length of the cephalo-thorax should be taken as implying the direct distance between the lower edge of the clypeus and the central part of the posterior margin of the thorax. This measurement is best made by means of an accurate divider with curved needle points.

Connected with the cephalo-thorax are the following structures, which are described separately:—Eyes, Sternal-plates, Falces, Palpi, Legs.

Eyes. The eyes of spiders are invariably simple and are normally eight in number. In a few British species only six are present, whilst in some exotic spiders the number is still further reduced to four or occasionally two. Two forms of eyes are found, which Mons. E. Simon, conceiving a difference in their respective functions, designates *diurnal eyes* and *nocturnal eyes*.

2 See Plates VII. and VIII., with the explanations thereof on pp. 189-90 post.

With the belief that these two forms are respectively co-existent with diurnal and nocturnal habits I am quite willing to concur; but whether the eyes of the nocturnal type are specially adapted for viewing objects in a dim light or whether these organs are impaired by disuse, it is rather difficult to determine. Be this as it may, the two forms are in the majority of cases very distinct and are of some use in the separating, at any rate, of the more highly specialised species of several families. As might be expected many forms are found intermediate between the distinct diurnal eye and the nocturnal type. The diurnal eyes are perfectly, or almost perfectly round, usually of dark colours, or black, and of a strongly convex form. The nocturnal eyes are sometimes round, more often oval or even angular, of a pearly white tint and rather flattened. In some species the eyes are homogeneous (*i.e.*, all of one type, either diurnal or nocturnal); but in other cases they are heterogeneous, both types being co-existent in one species. The tract bounded by the eyes is known as the *ocular area* and the portion between the foremost eyes and the anterior edge of the caput is termed the *clypeus*. The expression "length of the ocular area" must be regarded as implying the measurement in a direction parallel to the main axis of the body. It will be noticed, therefore, that in the majority of spiders the ocular area is broader than long. Statements as to the straightness or curvature of a row of eyes are based upon measurements made from the centre of the eyes in question. It will be easily seen that the apparent curvature of a row of eyes upon a convex or uneven surface will depend greatly upon the position in which the creature is viewed. It should be understood that details as to the straightness or curvature are, as a rule, founded upon observations made in a line at right angles to the integument at the central portion of the row of eyes in question. The expression *recurved* indicates that the convexity of the curve is directed forwards, curvature in the opposite direction being denoted by the term *procurved*.

Sternal Plates. These are two strong chitinous pieces placed below the cephalo-thorax, one between the coxal joints of the palpi, the other between the coxæ of the legs. The former is known as the *Labium*, the latter as the *Sternum*. The Labium is a small plate, usually of a somewhat oblong or semi-oval shape, sometimes plane, at other times having its anterior edge turned outwards or thickened along its external surface, this form being known as *recurved*. The Sternum is a rather large plate, usually more or less oval or cordiform, which occupies the central portion of the inferior surface of the cephalo-thorax. To this structure the true legs are attached. In a few cases projecting portions of the sternum pass beyond the attachments of the coxæ, thus forming a kind of socket for the reception of each leg.

Falces. The falces are a pair of appendages situated beneath the anterior extremity of the cephalo-thorax. Each falx consists of a stout *basal joint* surmounted by a movable *fang*, this latter being pierced by a channel whose opening is near the point of the fang. Connected with each channel is a poison gland, sometimes placed within the basal joint, sometimes within the cephalo-thorax and sometimes partly in each. Upon the external surface of the basal joint is often found a smooth raised portion or *basal protuberance*, and in some species the falx is externally striated. This structure is apparently employed as a stridulating organ, being actuated in this capacity by a process upon the inner surface of the palpus. The fang, when at rest, lies in a depression at the extremity of the basal joint, known as the *fang-groove*: this latter is often provided, at one or both of its edges with teeth or *denticulations*. The basal joint is sometimes furnished towards its extremity with a dense tuft of hairs, known as a *scopula*.

Palpi. The palpi are a pair of limbs which are attached to the underside of the cephalo-thorax, one upon each side of the labium. Each palpus consists primarily of five distinct joints, *Coxa*, *Trochanter*, *Femur*, *Tibia* and *Tarsus*. These parts are also known amongst various authors as exinguinal, humeral, cubital, radial and digital joints

respectively. Each palpal coxa is furnished with an appendage in the form of a well developed plate known as a *Maxilla*. The maxilla often appears to be simply an enlargement of the coxal joint itself, but a transverse striation is usually evident, indicating the real distinctness of the two parts. The tibia of the male palpus is often furnished with one or more processes, known as *Apophyses*, and a patellary or femoral apophysis is occasionally present. In the female the palpus is more or less pediform, sometimes with and sometimes without, a terminal claw. In the male, however, a most curious modification of this organ is observed. The tarsal joint is as a rule more or less split or excavated, and connected with it is the external reproductive organization of the spider. The cup-like depression formed by the excavation of the tarsus is often termed the *Alveolus*. The spermal secretory glands are of an exceedingly simple structure, and their external opening, which is small and only detected with difficulty, is situated upon the underside of the abdomen, some distance in front of its central part. From this aperture the spermal fluid is absorbed, directly or indirectly, by means of the palpal organs and thence injected into the ovaries of the female. To the araneologist the palpi of male spiders are of paramount importance not only as reliable indications of specific identity but as characters upon which much of our systematic classification may with advantage be based. More detailed descriptions of the palpi will be given when the limitations of the groups founded upon the variation of these curious structures claim our consideration. It should be remembered that statements as to the position of certain parts of the palpus are made on the understanding that the limb is extended horizontally forward.

Legs. These are invariably eight in number, attached to the sternum, and each consists of seven joints termed respectively *Coxa, Trochanter, Femur, Patella, Tibia, Metatarsus and Tarsus*. The term "Protarsus" has been suggested as more accurately describing the position of the joint here termed the metatarsus. Theor-

etically this is so; but as this latter denomination has been almost universally adopted by arachnological writers I see no pressing necessity for the alteration. The legs are terminated by two or three curved and usually pectinated *Tarsal Claws*. These are almost always attached to the tarsus itself, but occasionally to a small supernumerary joint known as the *Onychium*. In some species a dense cluster of hairs is found beneath the extremity of the tarsus, known as a *Claw-tuft*, and a similar structure sometimes extends along the inferior surface of the joint, it being then known as a *Scopula*. In some families the metatarsi of the fourth pair of legs are each furnished with two closely set rows of short curved bristles, forming a kind of comb. This organ, known as the *Calamistrum* is always co-existent with a supernumerary spinning organ, and by its aid a peculiar flocculent web is drawn from this spinner and spread upon the snare. The calamistrum is absent in the adult male, whose spinners, however, are similar to those of the female. The relative length of the legs is often of some importance in classification, and is usually expressed by a formula. Thus IV., I., II., III., would indicate that the fourth leg was the longest, the first coming next in length, and the third the shortest. When two legs are of equal length the numbers denoting them are connected by a hyphen. Tibia I., tarsus IV., and similar expressions are often used, denoting the tibia of a leg of the first pair, tarsus of a fourth leg and so on. The legs are furnished with hairs, and usually with spines also.

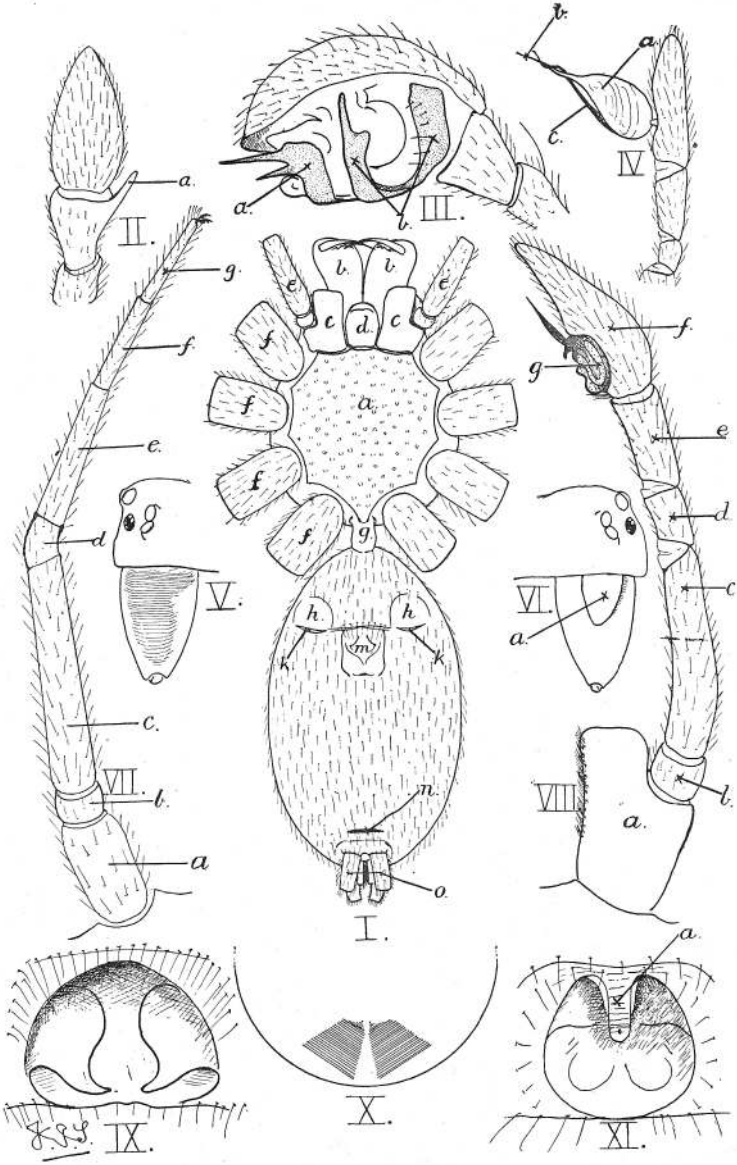
Abdomen. The posterior great division of the body is known as the abdomen. With the exception of one rare exotic species it exhibits no distinct segmentation, unless, indeed, the small *Anal Tubercle* which is often present may be regarded as a segment. The abdominal integument is usually pliant and non-resistant, but occasionally it becomes more or less coriaceous.

Spinners. Towards, or at the posterior extremity of the abdomen are several pairs of appendages known as the spinners. These organs vary in number in different

species, three pairs, however, being usually present. The spinners are more or less cylindrical, conical or mammiform and each is furnished with numerous small *Spinning Tubes*, each of which is capable of emitting a single silken thread. In some species an extra or supernumerary spinner, termed a *Cribellum*, is present. This organ is of a type different from the normal spinners, in front of which it is placed. Its form is very constant in the various families in which it occurs, being a transverse strip often with a central constriction, this latter indicating, apparently, that it has been formed by the fusion of a pair of abdominal appendages.

Spiracular organs. Two forms of respiratory organs are found in the Araneae—*Laminal Tracheae* and *Tube Tracheae*. The laminal tracheae, sometimes termed sac-tracheae, lungs, lung-sacs, or lung-books, are situated beneath the integument of the inferior surface of the abdomen. The organs themselves each consist of a number of exceedingly delicate laminae plentifully supplied with very minute vessels and communicating by a narrow transverse aperture with the atmosphere. The integument covering each laminal trachea is often of a different tint from the surrounding portions, and these parts are termed the *Spiracular-plates*. The tube tracheae open sometimes in one aperture and sometimes in two apertures, usually close to the spinners, but occasionally upon other parts of the under surface of the abdomen.

Reproductive organs. The sexual secretory glands of the male and the entire reproductive system of the female are situated within the abdomen, their external openings being placed with few exceptions, between those of the laminal tracheae. In the male the opening is very minute and inconspicuous, but in the female it is often provided with variously formed *Epigynal Plates*. In some cases the integument upon the anterior side of the female genital aperture is chitinised, produced downwards and backwards, and more or less modified in form, the resulting structure being known as the *Clavus*. The genital armature of the female is usually a most important criterion in the differentiation of obscure and closely allied species.



DISSECTIONS OF TYPICAL SPIDERS. *(For explanations see text.)*

14 DESCRIPTIONS OF PLATES.

PLATE VII.—DISSECTIONS OF TYPICAL SPIDERS.

Fig. I. Body reviewed from above, legs and palpi removed.

a. *Caput.*
b. *Thorax.*
c. *Eyes.*
d. *Median indentation.*
e. *Lateral indentations.*
f. *Pedicle.*
g. *Abdomen.*
h. *Spinners.*

Fig. II. Eyes, etc., from in front and above.

a. *Clypeus.*
b. *Falces.*

Fig. III. Eyes, etc., from behind and above.

a. *Falces.*
b. *Cephalo-thoracic indentations.*

Fig. IV. Spinners of the cylindrical type, viewed from beneath.

a. *Superiors.*
b. *Centrals.*
c *Inferiors.*

Fig. V. Spinners of the conical type, viewed from beneath.

Fig. VI. Spinners, viewed from beneath showing the *Cribellum* (*a*).

Fig. VII. Spinners of the elongate type, viewed from beneath.

Fig. VIII. *Tarsus*, and part of *Metatarsus* showing *Scopula*.

Fig. IX. Part of *Tarsus* showing *Claw-tuft*.

Fig. X. Part of *Tarsus* showing *Supernumerary Claws* (*a*.)

Fig. XI. Fourth *Metatarsus* with *Calamistrum* (*a*).

Fig. XII. Falx.

a. *Basal joint.*
b. *Fang.*
c. *Fang-groove.*

Fig. XIII. A single spinner *a. Terminal joint* with spinning tubes or *Spinnerets* *b Basal joint.*

PLATE VIII. DISSECTIONS OF TYPICAL SPIDERS, CONTINUED.

Fig. I. Body viewed from beneath, legs and palpi truncated (female).

a. *Sternum.*
b. *Falces.*
c. *Maxillae.*
d. *Labium.*
e. *Femoral joints of palpi.*
f. *Coxal joints of legs.*
g. *Pedicle.*
h. *Spiracular plates.*
k. *Laminal-tracheal openings.*
m. *Reproductive organs.*
n. *Tube-tracheal opening.*
o. *Spinners.*

Fig. II. Palpus, male, from above.

a. Tibial apophysis.

Fig. III. Palpus, male (*Linyphiinae*), in profile, viewed from the outer side

a. *Lateral stylum.*
b *Basal appendage.*

Fig. IV. Palpus, male. A simple form.

a. *Bulb.*
b *Stylum.*
c. *Conductor*

Fig. V. Caput in profile, showing striæ on falx.
Fig. VI. Caput in profile, showing basal protuberance of falx (*a.*)
Fig. VII. Leg

a. Coxa.
b. Trochanter.
c. Femur.
d. Patella.
e. Tibia.
f. Metatarsus.
g. Tarsus.

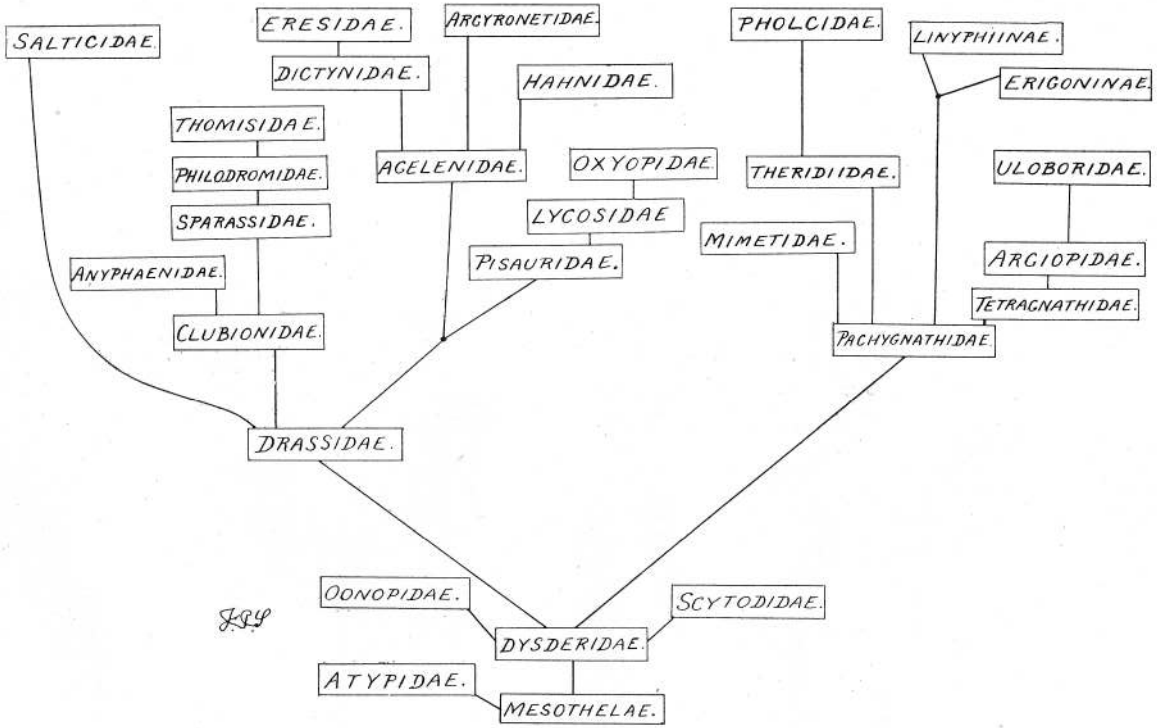
Fig. VIII. Palpus, male.

a. Maxillary plate.
b. Trochanter.
c. Femur.
d. Patella.
e. Tibia.
f. Tarsus.
g. Palpal organs.

Fig. IX. Vulva, without clavus.
Fig. X. Hind portion of thorax of *Phyllonethis*, showing striations
Fig. XI. Vulva with *Clavus* (*a.*)

II.—CLASSIFICATION.

In order to satisfactorily sub-divide this difficult and complex Order it becomes absolutely necessary to enter into the consideration of certain exotic forms. A system founded upon a limited fauna, such as that of the British Isles, would of necessity be more or less artificial and misleading, and certain groups which might then appear quite distinct, would become almost inseparable upon the insertion of exotic species. The difficulty of establishing a satisfactory system of classification is vastly increased by the widely diverse opinions held by various authorities as to the comparative importance of certain portions of the structure of the creatures under consideration. Again, unless certain links in the chain of evolutionary development have disappeared, classification becomes an impossibility, species, genera and families merging into each other to form perplexing and almost unmanageable series. In the case of the Araneae so many of the earlier forms remain, that groups whose more highly specialised representatives are totally dissimilar become inseparably linked by intermediate species and defy any attempt at a satisfactory broad sub-division by reason of the gradual development and elimination of those structural characteristics upon which our systems are based. With the discovery of new species the classification of a group becomes as a rule more complex and difficult, forms being thus found to bridge over the gaps between previously distinct genera and families. Were our knowledge of any group absolutely complete, both in regard to modern and extinct forms, *classification would become quite impossible*, as we should



SUGGESTED DEVELOPMENT OF THE BRITISH SPIDER FAMILIES.

find perfect gradations from the most ancient stock to the most highly specialised species. The early attempts at a systematic classification, not only of the Araneae but of almost all the Natural Orders of animals, were more or less of the nature of an arrangement, founded upon the most evident structural differences, intended to facilitate the conversion of a visibly heterogeneous order into several groups possessed of something like homogeneity. With the general acceptance of the various theories of evolutionary science, the systematist has not only endeavoured to elucidate the relation existing between order and order, or family and family, but has essayed to trace the development, through successive stages, of the most highly specialised creatures from the primary representatives of the group under his consideration. The order Araneae is, broadly speaking an exceedingly homogeneous one and the difficulty of satisfactorily characterising the various groups is exaggerated by the simplicity of structure exhibited. It should be borne in mind that the development of a group of animals from an original stock cannot be truly represented by any linear arrangement but rather by a genealogical "tree," the "root" corresponding to the elementary, and the "twigs" to the most highly specialised forms. In dealing with the evolutionary development of the Araneae I am aware that I am venturing upon dangerous ground. In this matter modern araneologists are not by any means agreed, as a very cursory glance at the more recent English and Continental publications will show; and I trust, therefore, that the accompanying diagram (Plate IX.) may be regarded simply as expressing the opinion of a single individual.

ORDER ARANEAE.

Head and thorax fused to form a single piece. Eyes simple. Abdomen almost invariably non-segmented, connected with the thorax by a slender pedicle, terminated by several pairs of spinners, each furnished with numerous spinning tubes. Respiratory organs consisting of laminal tracheae and tube tracheae, both kinds being usually found in one individual. (The tube tracheae are occasionally absent; and, very rarely, the laminal tracheae are wanting). Reproductive organs of both sexes situated between the anterior spiracular openings, but the ejactorial apparatus of the male is connected with the terminal joint of the palpus. Falces consisting of a stout basal joint and a movable fang, pierced with a channel and capable of injecting a poisonous fluid. Sternal plates two in number. Palpus of the female pediform. Legs eight, each consisting normally of seven joints.

The Araneae are oviparous creatures, without metamorphoses, feeding upon insects or other small animals which they capture either with or without the aid of a silken snare.

SUB-ORDER MESOTHELAE (Pocock).

Upper surface of abdomen with traces of segmentation in the form of distinct transverse plates. This small sub-order, of which we have no British representative, may be regarded as a transitional group, visibly approximating the Pedipalps, and, therefore, as the probable ancestral stock from which the various spider families have developed.

SUB-ORDER OPISTHOTHELAE (Pocock).

Abdomen apparently non-segmented. A small anal tubercle is often present which may reasonably be regarded as a vestigial segment, but no known representatives of this sub-order possess any structure which could be mistaken for the dorsal plates of the Mesothelae.

SECTION I. MYGALOMORPHAE.

Spiders with four laminated tracheae and with the fangs articulated so as to permit of motion iu a vertical plane.

The more ancient spiders included in this section exhibit striking affinities with the Mesothelae. The Mygalomorphae are of large size and, as a rule, not brilliantly coloured. One rather aberrant family is represented in this country, namely, *Atypidae*.

SECTION II. ARANEOMORPHAE.

Spiders with two laminated tracheae (with rare exception) and with one or occasionally two openings leading to tube-tracheae (absent in a few cases). The fangs are articulated so as to permit of motion in a horizontal or oblique plane.

Although apparently developed from a group identical with or closely allied to the Mesothelae, the earlier forms of Arachnomorphae do not approximate the ancestral type so closely in some respects as do the Mygalomorphae.

We may conveniently divide the Araneomorphae into three series, Dysderiformae, Drassiformae and Argiopiformae.

SERIES I. DYSDERIFORMAE.

Spiders of an early type with six nocturnal eyes and generally two tube-tracheal openings situated close to the laminal tracheae. The tarsus of the male palpus closely resembles that of the female, the joint being entire or occasionally very slightly hollowed. The palpal bulb is of extremely simple structure, usually more or less of a flask-like form and containing a spiral sperm tube. Palpal apophyses are not present. The genital aperture of the female is a simple transverse opening provided with neither epigynal plates nor clavus. The tarsal claws are sometimes two and sometimes three in number.

These spiders as a rule spin no snare, but usually fabricate silken tubes in crevices or beneath loose bark.

Three families are represented in Britain — Dysderidae, Oonopidae, Scytodidae.

SERIES II. DRASSIFORMAE.

Spiders with usually eight eyes and with the tube tracheae opening in a small transverse slit either just in front of the spinners or more rarely in the centre of the abdomen. In one family *Argyronetidae*, two tube-tracheal openings are present, placed very much as in the Dysderiformae. The eyes are sometimes heterogeneous and sometimes homogeneous being then of the diurnal type. The tarsus of the male palpus is more or less enlarged and hollowed to receive the palpal organs. In the case of many of the more primitive types the alveolus is small and the joint only slightly enlarged, whereas in most of the highly specialised families the joint is greatly expanded and the alveolus often occupies the greater part of its lower surface. In many cases where these organs are of great complexity it is rather difficult to recognise the exact condition of the joint, but careful examination in different positions, aided occasionally by the use of the dissecting needle will convince one that the form of the tarsus itself, however modified it may be, has been produced by the hollowing out of the under surface of the more or less enlarged joint. It will be noticed as a consequence that the alveolus points directly downwards. The tibial joint of the male palpus is usually furnished with one or more apophyses. These are usually in the form of strong, chitinous projections, and are very often of a darker colour than the general surface of the joint. When only one apophysis is found it generally springs from the anterior external angle of the joint, and when several are present the most highly developed one will usually occupy this position Patellary and femoral apophyses are occasionally present. The genital aperture of the female is provided with more or less developed epigynal plates but is without a clavus. The tarsal claws are sometimes two and sometimes three in number.

These spiders as a rule spin no true snares, but a few species surround the extremity of their tubular retreats with a more or less extensive sheet of web and lie in wait for insects which may be unfortunate enough to alight upon this structure. A well known example of this form of web is found in the "cobweb" with which the corners of our rooms are adorned (?)

Fifteen families of Drassiformae are represented in this country, namely Drassidae, Clubionidae, Anyphaenidae, Sparassidae, Philodromidae, Thomisidae, Salticidae, Agelenidae, Hahnidae, Argyronetidae, Dictynidae, Eresidae, Pisauridae, Lycosidae, Oxyopidae.

SERIES III. ARGIOPIFORMAE.

Eight-eyed spiders with one pair of laminal tracheae and an indistinct opening leading to tube-tracheae placed not far from the spinners. In one or two instances tube tracheae are apparently absent. The tarsal claws are

three in number, and in some species a number of minute supernumerary claws are found, opposed to the ordinary ones. The eyes are sometimes heterogeneous and sometimes homogeneous, in that case being of the diurnal type. In some species the caput of the male is elevated in a most remarkable manner, several of the eyes being often placed upon the raised portion. The development of the tarsus of the male palpus from the simplest forms to the most complex is very curious and interesting. Instead of the joint being modified by a hollowing process to receive the palpal organs, it is split longitudinally, this structure being very clearly seen in *Pachygnatha*, the genus from which apparently the argiopiform spiders have developed. In this case we find both branches of the split joint very distinct and between them the bulb of a very simple form and provided with but few appendages. From this genus we can trace four distinct lines of development. The first series, developing through Tetragnatha and Meta, gives rise to orb-spinning spiders such as those of the genus Aranea and, possibly, the cribellate family Uloboridae. The second terminates in the spiders of the "Walckenaëra" type, the males of which possess, as a rule, curious cephalic prominences and tibial apophyses upon the palpi. The third tends towards the higher types of the "Linyphia" group with well developed spines upon the legs and highly complex palpal organs. From the fourth we may trace the Theridiids, with the aberrant family Pholcidae. With the structural development of these various types the palpus has undergone great modifications, notably in the gradual elimination of the external branch of the tarsus. The remaining branch (*i.e.* the internal one) often becomes of a cup-shaped form, reminding one strongly of the palpal tarsus of some of the Drassiform spiders, but with the most important difference that the palpal organs are placed upon the external surface of the joint instead of upon its under side. The palpal organs, too, are usually far less enclosed by the tarsus than in the Drassiformae, the joint being often reduced to very small portions. The modified external branch of the divided tarsus is found in several groups of Argiopiform spiders. It is rather conspicuous in many of the representatives of the sub-family Linyphiinae of the family Linyphiidae and has been often referred to under the term "falciform process."

The Argiopiformae are for the most part deprived of tibial apophyses, but in some groups, notably the sub-family Erigoninae these structures are very strikingly developed. They are, however, of a form very different from that exhibited by the Drassiformae. In the first place they are not nearly as distinctly defined, being, as a rule more or less of the nature of expansions of the joint itself, thus rendering it in many cases a matter of some difficulty to decide exactly where the joint terminates and the apophysis commences. Their position, also, is very characteristic, for they are usually placed upon the superior anterior portion of the tibia, projecting considerably over the tarsus and thus precluding any great vertical motion of the joint. The lateral motion, necessitated by the external placing of the organs, is thus in no way impeded. The genital aperture of the female, except in a few primitive types, is furnished with epigynal plates, and often with a clavus also.

The Argiopiformae almost invariably fabricate some form of snare. In the majority of cases it consists of a horizontal sheet of irregular threads

upon the under side of which the spider clings in an inverted position. The ensnaring capabilities of this sheet are often greatly increased by the presence of numerous fine threads crossing and recrossing some distance above it, and intended to trip up any unlucky insect which happens to fly against them. Many argiopiform spiders spin orbicular snares, the "garden spider" (*Aranea diademata*, Clk.) being a familiar example.

Eight argiopiform families are represented in this country, namely, Pachygnathidae, Tetragnathidae, Argiopidae, Uloboridae, Mimetidae, Theridiidae, Pholcidae and Linyphiidae.

This arrangement may be summarised for British species as follows:—

ORDER ARANEAE.

SUB-ORDER MESOTHELAE (no British representative).

SUB-ORDER OPISTHOTHELAE.

Section I. MYGALOMORPHAE.

Family Atypidae.

Section II. ARANEOMORPHAE.

Series I. Dysderiformae.

Family Dysderidae.
,, Oonopidae.
,, Scytodidae.

Series II. Drassiformae.

Family Drassidae
,, Clubionidae
,, Anyphaenidae
,, Sparassidae
,, Philodromidae
,, Thomisidae
,, Salticidae
,, Agelenidae

Family Hahnidae
,, Argyronetidae
,, Dictynidae
,, Eresidae
,, Pisauridae
,, Lycosidae
,, Oxyopidae

Series III. Argiopiformae.

Family Pachygnathidae
,, Tetragnathidae
,, Argiopidae
,, Uloboridae

Family Mimetidae
,, Theridiidae
,, Pholcidae
,, Linyphiidae

It will be noticed that many of the primary divisions of the order are founded upon characters which, although systematically of paramount importance, are very obscure and, in some cases, confined to one sex. The differentiation of the spiracular systems, for example, would be certain to utterly confuse the beginner, necessitating as it does the most delicate methods of

dissection. I propose, therefore, to insert the following tables which, although founded primarily upon the most obvious rather than upon the most important characteristics, and intended only for the identification of British species, will no doubt assist the beginner in his endeavours to decide the systematic position of his captures. Conclusions drawn from this table, however, should be checked by reference to the short descriptions of the families which will be given in their proper position in the classified list. This remark should be taken as applying to all analytical tables, for without some such precaution they become a source of grave danger. To pin one's faith to such scanty details as can be included in them is to court inaccuracy, and the conclusions drawn from such a procedure, although arrived at with comparative ease, do not in any wise convey that feeling of satisfaction which is experienced when the structural characteristics of a specimen are found to coincide, one by one, with the details of a well-written description.

TABLE OF FAMILIES OF BRITISH ARANEAE.

1.	Eyes six	2
	Eyes eight	4
2.	Eyes in three widely separated groups, these groups forming a triangle with its apex in front	Scytodidae
	Eyes in one group	3
3.	Openings of tube tracheae close to laminal tracheae and very distinct. Eyes of moderate size. Falces rather powerful ..	Dysderidae
	Openings of tube tracheae well separated from laminal tracheae and very obscure. Eyes very large. Falces weak	Oonopidae
4.	Eyes arranged in three groups of 3, 2, 3, placed transversely	5
	Eyes either in three groups of 2, 4, 2 or in two, three or four transverse rows	6
5.	Falces very powerful. Legs short and strong	Atypidae
	Falces very weak. Legs very long and slender	Pholcidae
6.	Cribellum present	7
	Cribellum absent	9
7.	Cephalic region narrow	Uloboridae
	Cephalic region more or less broad and massive	8
8.	Eyes in two rows, more or less parallel, and fairly closely grouped	Dictynidae

	Eyes small, very widely separated, the posterior laterals being placed far back upon the caput	Eresidae
9.	Width of ocular area greater than its length. Eyes not greatly unequal in size ..	10
	Width of ocular area not greater than its length. Eyes very unequal in size ..	24
10.	Tarsal claws 2	11
	Tarsal claws 3	16
11.	Inferior spinners well separated at their bases..	Drassidae
	Inferior spinners set close together at their bases	12
12.	Eyes homogeneous, of the diurnal type. Posterior row recurved. Legs of second pair longer than those of the first and often than those of the fourth. Clypeus moderately high	13
	Eyes usually distinctly heterogenous (except *Sparassidae*). Posterior row often procurved. Legs of second pair shorter than those of the first and fourth pairs. Clypeus low	14
13.	Legs I and II much longer than legs III and IV. Tarsi without scopulae	Thomisidae
	Legs not greatly unequal. Tarsi with scopulae	Philodromidae
14.	Tube tracheae opening in a very distinct transverse impression near the centre of the abdomen	Anyphaenidae
	Tube tracheae opening just in front of the spinners, the aperture being small and inconspicuous	15
15.	Labium rather long. Eyes distinctly heterogeneous	Clubionidae
	Labium very short, almost semi-circular. Eyes almost homogeneous	Sparassidae
16.	Spinners short and arranged in a compact group	17
	Spinners of superior pair long, consisting of more than one joint	22
17.	Genital aperture placed some considerable distance behind the openings of the laminal tracheae	18
	Genital aperture placed between the openings of the laminal tracheae	19
18.	Legs without spines	Pachygnathidae
	Legs with spines	Tetragnathidae

19. Tibiae, metatarsi and tarsi of legs I and II with a row of long strong spines upon their undersides .. .. .. Mimetidae
Legs I and II without such spines.. .. 20

20. Tarsi IV with a double row of short curved spines upon their undersides. Remaining joints of legs usually without spines. Tibia of male palpus without apophysis.. Theridiidae
Tarsi without spines. Legs almost invariably furnished with spines which, however, are sometimes very minute and confined to tibia IV. In this latter case the tibia of the male palpus is almost always furnished with an apophysis 21

21. Height of clypeus greater than length of ocular area (except *Tapinopa* and *Tapinocyba*). Falces without basal protuberances .. Linyphiidae
Height of clypeus not greater than length of ocular area. Falces often with basal prominence .. .. .. Argiopidae

22. Tube tracheae opening in two apertures close behind the laminal tracheae .. .. Argyronetidae
Tube tracheae opening in a single aperture just in front of the spinners 23

23. Spinners normally arranged in a group .. Agelenidae
Spinners arranged in a transverse row beneath the extremity of the abdomen, the long spinners, corresponding to the superior ones of the Agelenidae, at the end of the row .. .. Hahnidae

24. Eyes in four unequal rows. Legs furnished with numerous very long spines .. Oxyopidae
Eyes in three rows of 4, 2, 2, four in the front row 25

25. Eyes of first row very large. Tarsal claws 2 .. Salticidae
Eyes of first row small. Tarsal claws 3 .. 26

26. Second row of eyes much shorter than the third. Clypeus high. Tibia of male palpus with an apophysis .. .. .. Pisauridae
Second row of eyes not much shorter than the third. Clypeus moderate. Tibia of male palpus without an apophysis .. .. Lycosidae

Note.—*Pholcomma gibbum*, a very minute Theridiid, has the eyes arranged as in Pholcidae. The caput of the male in some cases is elevated and the position of the eyes modified in consequence. Such species may be referred to the family Linyphiidae or more rarely to the family Theridiidae.

III.—PRACTICAL WORK.

Collection of specimens. The apparatus required for the capture of the Araneae is of a most unassuming and inexpensive type. An old umbrella should be obtained, and when the district to be visited does not offer facilities for cutting hedge-stakes a stout walking-stick must also be provided. A wide-mouthed, securely corked bottle of methylated spirit will be required, a few dry specimen tubes, a pair of tweezers, a note book, a newspaper and some strong tool which can be employed either for digging or for removing loose bark from tree-trunks. Every likely and unlikely situation should be systematically examined, and it must be remembered that many species will often be discovered under most unexpected conditions. Brick-bats, stones and boards which have lain undisturbed for some time should be carefully inverted and examined, also the holes in decayed tree trunks. Trees, bushes and tall herbage should be beaten or shaken above the umbrella, and grass and low growing plants pulled up and disintegrated over the newspaper. It is most important to recollect that the spiders thus obtained should be handled as little as possible. The neatest method is to hustle the specimen into a dry tube held in the left hand by means of the fingers of the right hand and thence transfer to the spirit bottle. Extremely minute species may be picked up by a wetted finger. The jumping spiders are, without doubt, the most difficult to capture, for beside the fact of their rapid and erratic movements, their bodies are often ornamented with easily-detached scales upon whose presence much of the value and beauty of a specimen depends.

Examination of Specimens. The method of examination of spirit preserved spiders is of great importance, and I therefore append a few hints.

A compound microscope must be regarded as a necessity, but a simple and inexpensive stand will meet all requirements. With regard to objectives a 2-inch, 1-inch and $\frac{1}{2}$-inch will be found amply sufficient for all ordinary work. A rather low-power eyepiece should be selected, and a good stand-condenser will be necessary. Armed with this very modest array of optical accessories we may proceed to examine a specimen with a view to determining its identity. A small china saucer should be procured—the top of a pomade pot is all that can be desired—

and partially filled with clean methylated spirit. In this the specimen should be placed and examined whilst entirely submerged. When working by artificial light the bulls-eye condenser will be necessary to obtain satisfactory illumination. A preliminary examination should be made with the lowest power, the higher magnifications being only necessary for viewing such points of structure as the palpal organs, epigynal plates, tarsal claws, etc. Beginners would be well advised to attempt the identification of none but adult specimens.

Preservation. Spiders are best preserved in methylated spirit, which should be slightly diluted by the addition of from five to ten per cent. of distilled water. Much of the spirit now supplied will turn cloudy on the addition of a small percentage of water; but the clearness of the mixture may be restored by the addition of more spirit. Other liquids have been tried wit' more or less success, but to me they all appear vastly inferior to methylated spirit. Rum, however, will be found a most useful preservative for such specimens as are intended for dissection. Specimens may be stored either in corked tubes or in stoppered bottles. The former method has the disadvantage that in the event of being left for some time unreplenished the spirit is liable to evaporate and the specimens are thus irrecoverably destroyed. With stoppered bottles one of two methods may be adopted. If space and purse permit, a separate bottle may be kept for each species; but, in the event of one or both of these items being somewhat limited, resource may be had to another system. Glass tubes are taken and arranged round the inside of a large stoppered bottle and are kept in position by a central plug of cotton wool. Sufficient spirit is then poured in to submerge and fill the tubes. The specimens are placed in the tubes together with a label written with lead pencil or Indian ink, and each tube is plugged with a small pad of cotton wool. When a specimen is required for examination, the containing tube may be removed by means of a large pair of forceps, and the spider then emptied into the china saucer before mentioned.

Recording Observations. Careful notes should be made of all habits observed, of local captures, of dates of appearance in adult state, of snares formed and of other matters of importance or interest. The greatest care however, should be exercised in order to render such data of absolute accuracy, for an erroneous statement, like a snowball on a hill, is not only more easily

started than stopped but is very liable to increase in volume as it travels. If doubtful occurrences are noted they should be liberally embellished with marks of interrogation.

LITERATURE.

A few remarks upon modern araneological literature may be of use, although in a work of this kind anything like a complete bibliography would necessitate the expenditure of an unjustifiable amount of space. The student should have access, if possible, to the following works, all of which are in the English language.

1861. John Blackwall. *A History of the Spiders of Great Britain and Ireland* (Ray Society). The descriptions are fairly useful and there are coloured illustrations of 273 species.

1879-82. Rev. Octavius Pickard-Cambridge. *The Spiders of Dorset* (Dorset Field Club). The descriptions are as a rule very complete and lucid. The illustrations are, unfortunately, very few in number.

Published at intervals by the same author numerous papers in *Proceedings of Dorset Field Club;* by Frederick O. Pickard-Cambridge many valuable contributions to *Annals and Magazine of Natural History*, etc., by Rev. John E. Hull and Dr. G. H. Carpenter several papers upon North of England and Irish spiders respectively.

1899-1902. *An Introduction to British Spiders* by the present author, published in *Science Gossip*. A synonymic list with many illustrations. The descriptions, owing to limitation of space, are extremely short and in many cases inadequate for purposes of identification.

1900. Rev. Octavius Pickard-Cambridge. *A List of British and Irish Spiders*. Copies of this valuable list may be obtained from Mr. Pickard-Cambridge, price 3s.

(To be continued).

GEOLOGICAL NOTES ON THE NEW RAILWAY BETWEEN ILFORD AND WOODFORD, ESSEX.

By T. V. HOLMES, F.G.S., *F. Anthrop. Inst., Vice-President E.F.C.*

This new railway leaves the Great Eastern Main-line between Ilford and Seven Kings Stations. Thence its course for more than three miles is nearly due north, a little east of Ley Street and Barking Side and across Fairlop Plain. But before reaching Manor Road, which connects Woodford Bridge and Chigwell Row, it makes a westerly turn, and crossing the Hainault and Chigwell roads a little south of their junction near Chigwell, passes between the farmhouses known as Newbarns and Luxborough, and bending southward joins the Loughton, Epping and Ongar branch about midway between the stations of Woodford and Buckhurst Hill.

The sections visible along its course were either between its Ilford end and the Cran Brook, on the northern side of Ley Street, or from a few yards south of the Manor road to a few yards west of Chigwell Road. Between the Cran Brook and the cutting which begins south of Manor Road the line is on an embankment. West of the Chigwell Road the surface of the ground rapidly slopes down to the level of the marshes of the Roding, which are crossed by the new line on an embankment. There is a short slight cutting close to the junction with the Loughton branch.

Looking northward from the Ilford end of the new line, a glance shows that thence to Ley Street the cutting is in old Thames river deposits, the height of the flat surface above ordnance datum rising gently northwards. It is about 40 ft. at Cauliflower Lane (*a*) the most southerly road crossed; a little more than 50 ft. at Ward's Lane (*b*); while at Hatch Lane (*c*), close to but south of Ley Street, it is from 68 to 70 ft., where the line crosses. The beds in the cutting between these lanes consist of gravel, or gravel and sand at the bottom, capped by a variable thickness of loam. No peaty beds were seen. But at one spot, a little north of Ward's Lane, some calcareous concretionary lumps appeared towards the bottom of the loam. They were, in all probability, the remains of a bed of shell marl. The surface loam thickened considerably between Cauliflower Lane

and Ward's Lane, but its thickness was constantly varying. London-clay was visible for a horizontal distance of about 10 yards, at the bottom of the cutting, about 80 to 90 yards north of Ward's Lane. The cutting from Cauliflower Lane to Hatch Lane is 10 or 11 feet in depth.

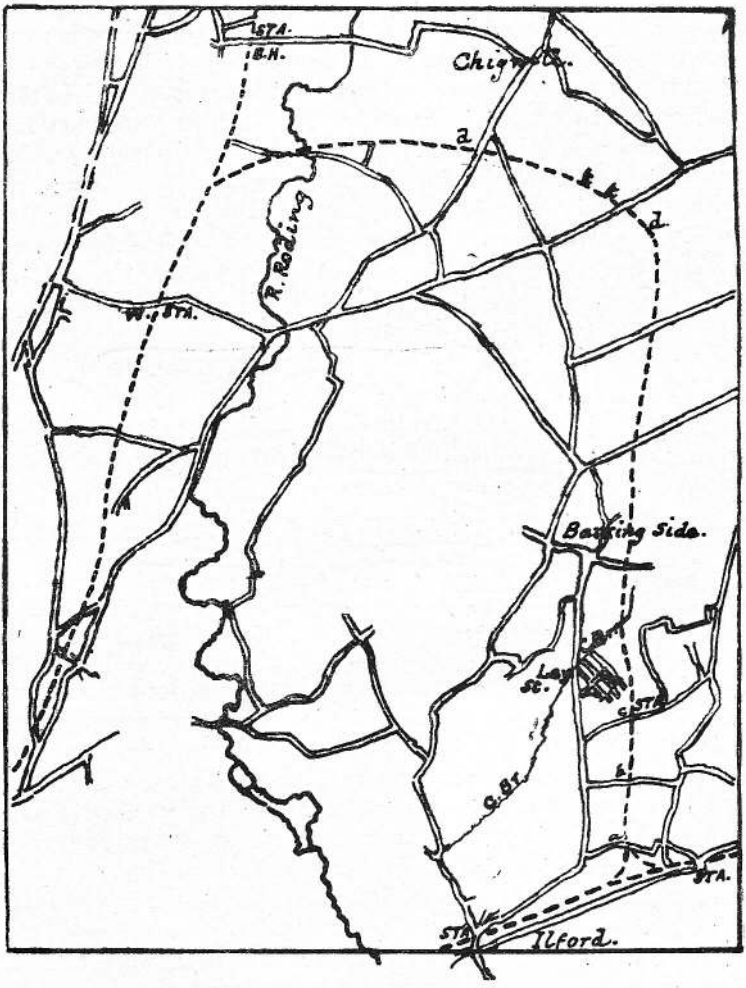


FIG 1 Sketch-map of Railway between Ilford and Woodford.

Railways - - - STA = Station. B.H. = Buckhurst Hill. a = Cauliflower Lane. b = Ward's Lane. c = Hatch Lane. C.Br. = Cran Brook. d - - d = Extent of Cutting. t - - t = Tunnel. Scale, 1 inch to the mile.

About 100 yards south of Hatch Lane there were some curious pipe-like hollows in the surface loam on the western side of the cutting, the origin of which seems at first sight not easy to explain. It appears to me that in this matter we shall obtain light from the appearances presented where the artificial bank bounding the channel of the present Thames has excluded a certain portion of the alluvial flat. In the excluded portion we see river deposits exposed to influences to which they were everywhere subject before man embanked the stream. In the surface loam are many irregular hollows, begun as broad surface cracks and deepened by rain. Similar hollows in old deposits would become liable in times of flood to be more or less filled with water bringing with it fine gravel and sand. Probably the hollows shown in Fig. 2 also owe something to the influence of

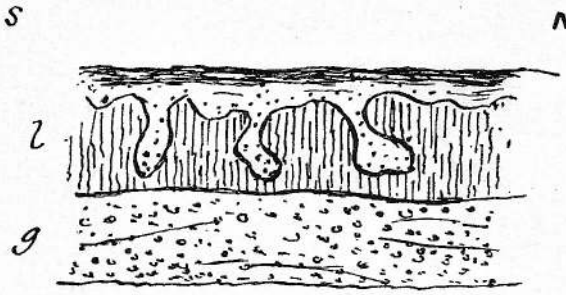


FIG. 2. Pipe-like hollows in the loam S. of Hatch Lane.
l = loam. g = gravel.
Height of section about, 11ft. Breadth 22ft.

ice. The kind and amount, however, of the ice-action they suggest is not that of the Glacial era during the deposition of the Essex Boulder clay, but rather that of a severe winter of the present day, such as occurred in 1894-5. Then we saw the Thames covered with blocks of ice which floated up with the tide and became stranded here and there during the ebb. Masses of this kind floating in the more ancient Thames would not, as now, be confined to its channel, but would often be deposited, during exceptionally high tides, over the adjacent alluvial flats. In some cases they would bear with them a certain amount of sand, gravel or animal remains. And they would be extremely likely, through the very variable amount of pressure on the surface loam, caused by their irregularities a-

regards size and distribution, to alter the shapes of the sand-filled hollows from their originally simple forms to the apparently abnormal outlines they present in those figured here.

Where the railway crosses Hatch Lane, a slight ridge north of the lane marks the presence of the southern boundary of a slightly higher and older terrace of old Thames deposits than the beds seen nearer Ilford. Hence on the slope of this ridge we find the London-clay at, or close to, the surface, its presence being slightly obscured by the washing down the slope of the gravel capping the ridge. The cutting north of Hatch Lane, and east of the compact collection of houses known as Ley Street, showed the rise of the London-clay towards the southern boundary of this ridge. A few yards north of the bridge which crosses the line near the School, on the northern side of the Ley Street Station, the London-clay sinks to the

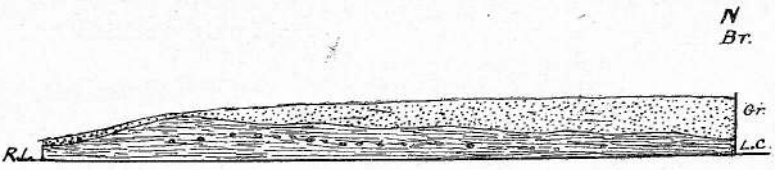


FIG. 3. Section from Hatch Lane, at Ley Street R. Station, to the Bridge over the Railway near the School, Ley Street.
Gr., Gravel. L.C., London clay. Br., Bridge.
Length of Section about 430 yards. Height, at bridge, 20ft.

level of the line. The ridge, north of this bridge, gradually decreases in height towards the Cran Brook. At the northern end of Ley Street Station the height of the surface appears to be about 85 feet above ordnance datum.

As this Ley Street terrace is cut in London-clay, its boundary is not clearly traceable for any distance. But its general course near Ley Street appears to be nearly due east and west, keeping a little south of the farmhouse called Great Newbury, east of the railway, and crossing Horns Road westward, close to but north of its junction with Hatch Lane. The Ley Street terrace, being older than those southward, has been longer subject to denuding agencies than they have been. Therefore, while the general level attained by the old river deposits north of the Cran Brook shows them to belong either to the Ley

Street terrace or to an older one, the slight valleys worn in the gravelly plain to the underlying London-clay tend much to obscure its nature and real elevation, when viewed from a point between Ley Street Station and the Cran Brook.

Beyond the Cran Brook northward, there are, as already mentioned, no cuttings for a distance of more than two miles. The next begins in a field on the more southerly side of Manor Road, between Grange Hill and Frog Hall, where the line begins to turn westward. North of Grange Hill Farm there is a tunnel about 270 yards long, westward of which is an open cutting as far as Newbarns Lane, west of the road between Chigwell and Woodford Bridge. Beyond the spot at which the line crosses Newbarns Lane are the marshes of the Chigwell Brook and the Roding which are traversed by means of an embankment. And the slight cutting close to the junction with the Loughton line is too shallow to afford anything of geological interest.

Between Manor Road and Newbarns Lane the cuttings and tunnel are in London-clay. But here and there west of the tunnel there are many pebbles on the surface of the clay, especially near the spot at which the Hainault Road crosses the line. The new railway here touches the northern boundary of a patch of gravel which is shown on the map of the Geological Survey (1. N.W. drift edition) as existing mainly south of the line and between the Hainault and Chigwell Roads. It is coloured as old river gravel, and is about a mile north-west of the gravel of Fairlop Plain and fifty or sixty feet higher in level. It would, therefore, appear to be of more ancient date than that of Ley Street and Fairlop Plain, and of less antiquity than the glacial gravel north of Chigwell. The railway cutting, however, does not afford any good sections in this gravel; that which appears here and there towards its top having been apparently washed down from the land south of the line.

East of the new line, in a field south of Manor Road at its junction with Vicarage Lane, appear, in old English letters, the words "Cing well (site of)." This is, I suppose, the well alluded to by Mr. Whitaker (*Geol. Lond.*, etc., vol. I., p. 504) when speaking of the sandy beds in the London-clay which sometimes give rise to small springs, frequently medicinal—"I have heard that a spring on the south of Chigwell Row was much appreciated in the neighbourhood."

EOLITHIC IMPLEMENTS FROM THE PLATEAU GRAVEL AROUND WALDERSLADE, KENT.

By J. P. JOHNSON.

[*Read March 8th, 1902*].

My attention was first drawn to the occurrence on the higher ground around Walderslade (which is a delightful little place nestling in a hollow in the North Downs near Chatham) of flint implements belonging to the earliest, or Eolithic, period of the Stone Age, when engaged in surveying there during the latter part of last year, 1901. They were always associated with characteristic plateau gravel *dèbris* in the shape of pebbles of chert, pieces of ironstone and the peculiarly stained flints. But most of them came from one or two spots near the escarpment where, judging from the abundance of these last in the surface soil, there must still be some patches of this early drift left *in situ*.

It is my intention in this paper to figure and describe some of the more interesting of these implements, but in order that they may be more readily understood it will be necessary to include a few remarks on Eolithic implements in general.

In 1889 Sir Joseph Prestwich gave an account of some very primitive flint implements which had been discovered by Benjamin Harrison around the village of Ash on the chalk plateau known as the North Downs. From their peculiar red-brown colour he connected them with an old gravel of which only a few patches now remain on the highest portions of the plateau, the main mass having been removed by denudation. Since then pits have been sunk in the neighbourhood and the contemporaniety of the implements with the plateau gravel has been established beyond doubt. This gravel is the oldest deposit[1] which has yielded relics of prehistoric man, and the rudely trimmed pieces of flint which it contains constitute the very earliest attempt of prehistoric man to make a piece of stone suitable for use as an implement.

1. The chipping on certain flints from deposits of greater age have from time to time been brought forward as evidence of their use by man or a man-like animal, but they are hardly convincing. A concise review of the question will be found in Mr. E. T. Newton's address to the Geologists' Association in 1897, with whose impartial conclusions one is disposed to agree. On the other hand it is only fair to add that Mr. A. Rutot (*Bulletin de la Société d' Anthropologie de Bruxelles, vol. xix.*, 1901) accepts the artifical nature of the chipped flints from the Miocene strata of Thenay, Puy-Courny and Otta, and from the Pliocene deposits of Saint-Prest. The Plateau Gravel is probably of late Pliocene age.

Indeed the plateau gravel may even contain traces of man dating back to a time before he had learnt to fashion flint implements for himself. For no doubt he employed flints of suitable size and shape in breaking open bones for the sake of their marrow, and in analogous ways, long before he became acquainted with the art of modifying them for purposes to which they were not naturally adapted. Indeed it was no doubt through such use that he first became acquainted with the peculiar properties of fracture possessed by flint, the knowledge of which was to play so important a part in his future career. Though flints battered and splintered in this way are seldom

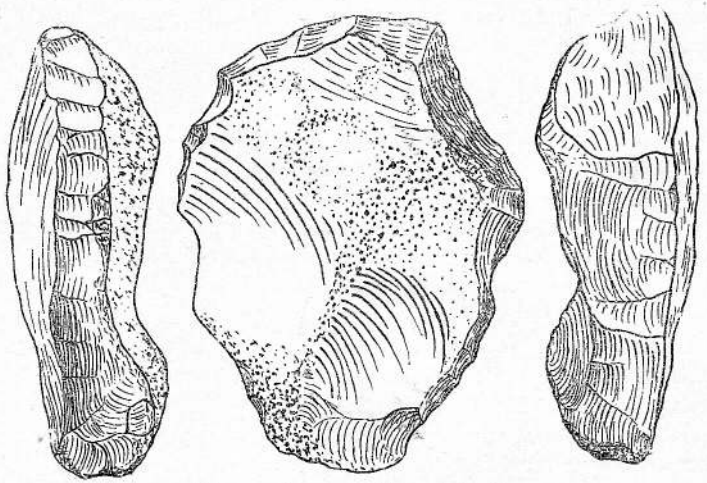


FIG 1. Scraper. (Actual size.)

distinguishable from those that have been much knocked about by natural agencies, such for instance as the action of a torrent, yet now and then the handiwork of man can be recognised in them. And possibly some of the battered flints from the plateau gravel, the fractured surfaces of which, from their very much worn and abraded condition, would seem to be older than the deposit itself, bear traces of use which date back to a time anterior to that at which he discovered the way to work flint.

Even the recognisable implements are of so primitive a character that their artificial origin was for long, and indeed is still, disputed by a great number of anthropologists. But while

no doubt much of the work of Eolithic man is indistinguishable from that of natural agencies, much on the other hand is very different and often bears a striking resemblance to that on the more makeshift of the tools of later periods. And one must remember that the similarity of many of these implements to the products of nature is only what one might expect since they are man's first attempts, especially when one takes into consideration the fact that most of these tools at least were of a temporary nature, being made when occasion demanded, and thrown away immediately after use.

One of the greatest obstacles to the general acceptance of these chipped flints as the work of man has been the difficulty of assigning any definite use to them, but in this connection one must remember that the purposes for which many of the indisputable implements of later periods were intended are also quite inexplicable.

Probably one of the first uses to which a flint was put, was the scraping of the adherent flesh from the inside of a newly removed skin. For this purpose the piece of flint employed must have a regular edge, but as this condition is rarely met with in nature, it was usually necessary to remove the irregular portions by chipping. It is to this class that the majority of the Eolithic implements belong. The "scraper," indeed, is one of the commonest of prehistoric implements and is still to be counted among the domestic appliances of certain savage races.

A good example of a scraper is shewn in fig. 1. It is a tabular piece of flint with the edge trimmed or bevelled by chipping. The dotted parts of the drawing represent the original crust of the flint, and the lined portions, the fractured surfaces: of the latter only the small chippings shewn in the side views are artificial. The chipping is of the same deep red-brown and opaque colour as the rest of the outside of the flint.

Another type of scraper is represented by fig. 2. The working in this case is translucent and, although much stained, is therefore fresh in appearance when compared with the body of the flint. The knob at the end was probably used as a handle. The fashioning of a scraper from a knobbed piece of flint is peculiar to Eolithic man.

A frequently occurring modification of the scraper is an instrument corresponding to the modern spokeshave. In this the modified edge instead of being either convex or straight, is concave. The concavity may range in shape and size from a small semicircle—such as was probably employed for scraping pieces of wood or bone into the form of pins—to comparatively large and slight curves—such as would be used for scraping any rounded surface.

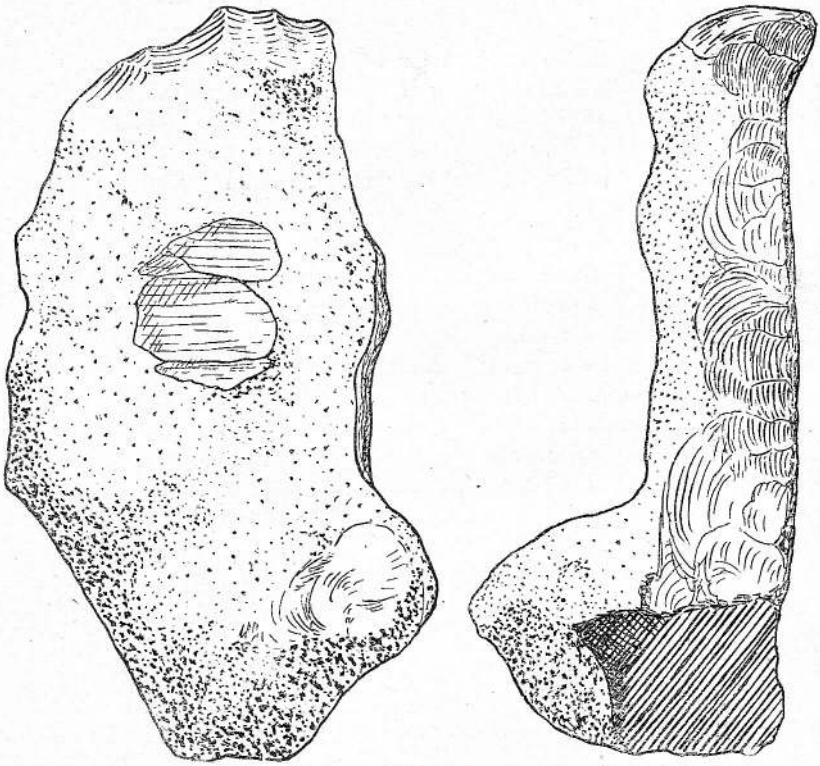


FIG. 2. Scraper with knob of flint left as handle. (Actual size.)

The double form of concave-edged scraper shewn in fig. 3, is very characteristic of this period.

Figure 4, represents a neat little spokeshave in my collection. One might at first be inclined to think that the use of so large a piece of flint in manufacturing so small an implement was a

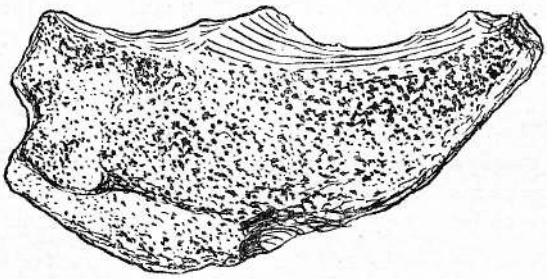


FIG. 3. Double concave-edged Scraper (Actual size,)

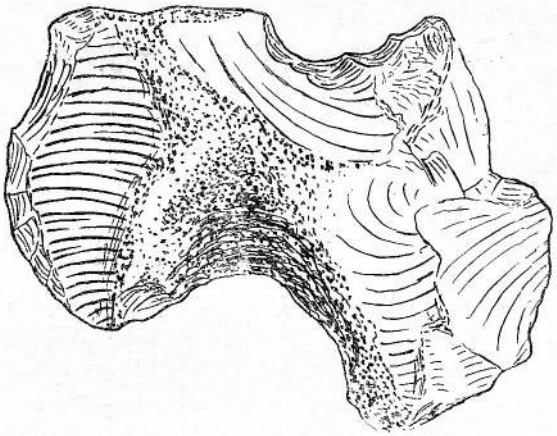


FIG 4 Spokeshave (Actual size.)

waste of material, but I find that the shape of the flint is particularly well adapted for grasping in the hand, and that the maker would seem to have taken this into consideration in selecting the position for the hollow.

The only other really abundant implement is the borer, which, as its name implies, is a pointed tool[2] used for making holes in soft substances such as wood. In some the points are short while in others they are long and tapering. Fig. 5 is a good example.

The massive pointed implement represented by fig. 6 is noteworthy. I can say little more of this than that there are many ways in which such an implement could be employed.

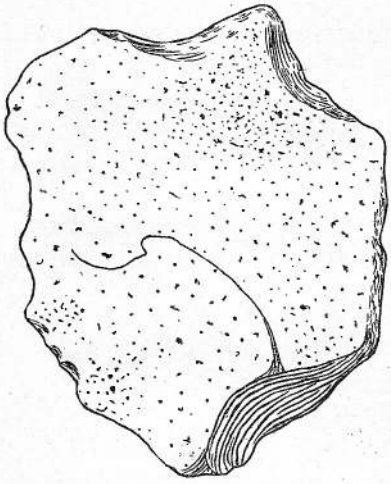


FIG. 5. Borer. (Actual size.)

The working, being of an opaque yellow colour, is much lighter than the rest of the flint. As in the other specimens figured in this paper the reverse side is a more or less plane surface.

The implements found in the plateau gravel range over a very long period of time. This is shewn by the association of unworn with much rolled specimens, and by the occurrence of the most crude forms side by side with comparatively well-finished examples.

2. The bluntly pointed implements though resembling Borers are probably double Spokeshaves. Rutot (l.c.) says "les poinçons, qui ne sont peutêtre que de simples grattoirs à deux encoches, la point étant sans usage."

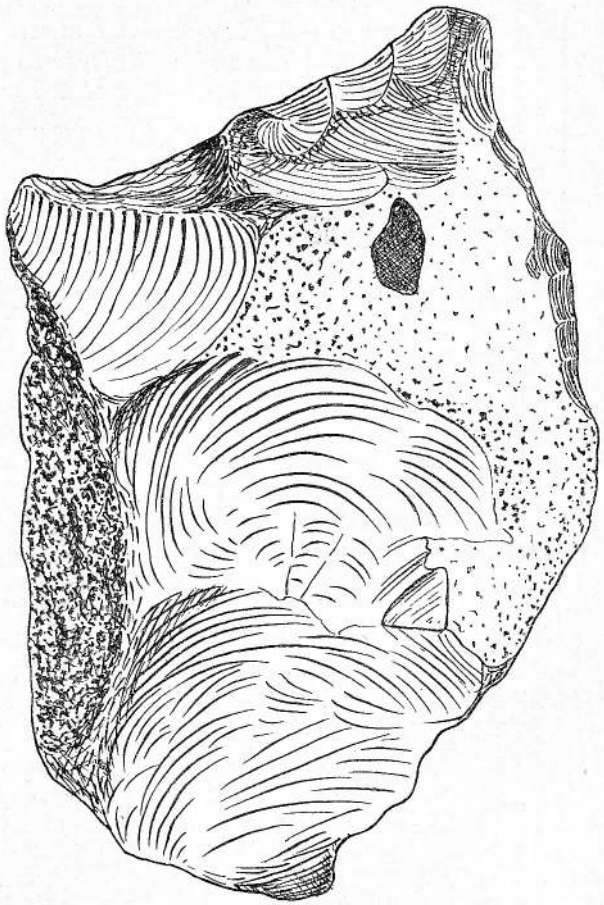


FIG. 6. Massive Pointed Implement. (Actual size.)

FIG. 7. Vertically exaggerated Section from Ash to Swanscombe, shewing the relation of the different implement-bearing deposits of the Thames Basin. (The correlation of the patch of gravel overlooking the high-level valley-drift at Swanscombe, with the plateau gravel, though probably correct, is not yet certain, owing to the absence of any sections in it.)

What the makers of these implements were like is quite unknown as no human bones nor indeed any contemporaneous organic remains have ever been found in the plateau gravel. Nothing of that sort could be preserved from such antiquity in so porous a deposit. Our knowledge of the animals with which these people were associated and hence of the approximate conditions under which they lived is little better, though a slight clue is afforded by the occurrence in a drift at Dewlish of Eolithic implements together with the bones of an extinct species of elephant—the *Elephas meridionalis* of Nesti —which did not survive into the succeeding Palæolithic period.

The relation of the plateau gravel to the other implement-bearing deposits of the Thames Basin is well shewn by the accompanying section (fig. 7), and may be briefly tabulated thus :—

Pliocene ..	Plateau Gravel ..	Eolithic.
Pleistocene	{ High-level Valley Drft { Low-level Valley Drift	} Palaeolithic.
Holocene ..	Alluvial Flats ..	{ Neolithic { —Historic.

Implements of Eolithic type have been found at several localities in Britain outside the Thames Basin[1] the most noteworthy being Dewlish and Alderbury. They also occur on the adjacent mainland of Europe[2] and in South Africa.

For the use of those who would like to go more deeply into the interesting problems connected with Eolithic man, I have appended a list of the more important papers that I have been able to consult in the preparation of this account. In this connection

1. As new records I may mention that I have obtained Eolithic Implements from among Plateau Gravel *débris* overlooking the railway-station in the Chipstead Valley and from the heights above Dover, both localities being on the North Downs.

2. The implements from the Plateau Gravel roughly correspond to the "Reutelian" and

I have received much help from my friend Kennard, who has kindly lent to me his extensive collection of pamphlets dealing with this subject, and I take this opportunity to express my thanks to him.

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"Mesvinian" of Rutot, who however considers that the latter stage only is represented. Nevertheless owing to the fact that the implements from the Plateau Gravel are not all of the same age but range over a long period of time, quite as primitive forms as the Reutelian are met side by side with the better finished types (Mesvinian) such as are figured in this paper.

Rutot is certainly under a misapprehension when he thinks he finds contemporaneous Reutelian implements at the base of the brickearth (low-level valley drift) at Erith, although he offers a very ingenious explanation. He however overlooks the occurrence in the immediate neighbourhood of an indisputably older deposit (the high-level valley drift) which contains Palæolithic Implements and which of course is itself newer than the Plateau Gravel.

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NOTE.

At the reading of the above paper at the meeting on March 8th, 1902, Mr. A. S. Kennard made some remarks which are embodied in the following note, to which the author has replied. These observations will most conveniently be given here :—

"It is of the utmost importance that the attention of Essex geologists should be called to these Eolithic implements since without a doubt they will be found in the county if proper search is made. Examples which may be of this age have been found in the Thames gravels at Grays and Ilford but what is wanted is to find these implements in the higher and older gravels. Whether it is right to assign such names as 'borers,' 'spokeshaves,' 'scrapers,' &c., to these implements may well be questioned. We know nothing of the customs of these primitive folk and our only knowledge of the existence of these primitive folk is derived from these flints. It is unsafe even to compare them with existing savages since all or nearly all of these have reached a higher scale in development than that which the Eolithic folk had attained. Even with the later Palæolithic implements we know next to nothing of their probable uses and this remark applies to many Neolithic tools also. The only ground on which the use of such names can be defended is the necessity of using terms which will be understood by all students of anthropology, hence their employment should refer to shape only and not to probable use.

"These primitive implements are known from Belgium, France, Egypt and South Africa, but it does not follow that they are all of the same age. Each district must be worked in detail before we can speak definitely.

A. S. KENNARD."

"I heartily endorse my friend Kennard's remarks as to the necessity of employing caution in interpreting the uses of these primitive implements. I do not however believe that the possibility of discovering their purpose is quite so hopeless as he seems to think. If we can trace the evolution of any of these implements from the earliest to the latest periods of the Stone Age we may yet do so, and such an evolution is, in my opinion, clearly observable in the spokeshave—scraper group, the latter implement even having been observed in use among modern savages. Now if we could connect the scraper of the Eskimo and that of the Eolithic folk with an intermediate series of intermediate age, would we not be justified in assuming that the use was the same? It is certainly unlikely that any radical change would take place in the use of a particular type of implement.

"However it has not been my intention to dogmatise in my explanation of the uses of these implements, but rather to suggest. It is necessary in a general and introductory paper of this description to give an idea of the most probable way in which they would have been used, and that is all that I have done.

J. P. JOHNSON."

WALTON AND FRINTON, ESSEX, IN 1902.

REPORT OF THE EXCURSION OF THE CLUB, 7th JUNE, 1902.

By W. H. DALTON, F.G.S., *Hon. Memb., E.F.C.*

The cliff-section of Walton-Naze has been often described, the richly-fossiliferous sands of the Red Crag having constituted it one of the "happy hunting grounds" of the collector for more than half a century. Though but a few feet thick, it has been so assiduously searched that a very large proportion of the fauna of the Crag period has been found represented here. This is partly due to the way in which the shells are protected from the solvent action of percolating water by a thick bed of clay, capped in its turn with several feet of gravel, and partly to its slight coherence in comparison with that of the subjacent London-clay. This may sound paradoxical, in view of the direct object of the excursion, the study of the progressive degradation of the London-clay itself. But it is merely a question of relative coherence—loose sand above stiff clay—and the result is the formation of a sort of shelf of the clay, from which rises a second and steeper cliff, 15 or 20 yards inland of that which descends to the beach. The shelf is much modified by slipping, and by the erosion of channels for the escape of springs from the interior,

and is at some points a fairly steep slope. It is often masked by a mass of Crag sand, forming a talus of gentle gradient, on which the collector can lie prone, and fill his boxes at leisure, regardless of comment from Philistines occupying the cliff-top or the beach. The several beds extend inland, and outcrop successively on the western slope of the Naze peninsula, as shown on the Geological Survey map.

The effect of denudation on the various beds are characteristic for each. The porous and fairly coherent gravel on the top offers a vertical face. Never being saturated by the most prolonged rainfall, it remains in place till dislodged pebble by pebble, as the supporting grains of sand are removed by direct lateral lashing of rain or spray. The water it receives on its level surface sinks in, and escapes westward over the edge of the underlying clay into the Crag below. This clay, originally assigned to the Chillesford clay, which in Suffolk is interbedded with the Crag, is probably representative of the Post-Glacial freshwater bed of Clacton cliff, a correlation now published for the first time, and based partly on its lithological character and that of the superincumbent gravel, and partly on the presence, about midway in its thickness, of a seam of peaty matter and fossil wood, as at Clacton. This seam was of limited extent, and has now disappeared with the recession of the cliff, but fortunately some of the wood is preserved in the Club's collection at Stratford. This Post-Glacial clay or loam offers a nearly vertical face, being sufficiently sandy to absorb and discharge rainfall without becoming pasty or slipping. The Crag below it has a steep face for a foot or two, merging into the talus. Its basement bed of water-worn bones, teeth and pebbles, derived from the denudation in the Crag period of the London clay and of some deposits of intermediate age, is seldom visible, but a shark's tooth badly damaged, and a large piece of bone, were among the finds of the day. The London clay, rising to some 30 feet from the beach, has generally a steep face, but here and there springs oozing from the Crag have caused heavy slips, breaching the bank, and furnishing the waves with broken and semifluid material, incapable of resisting their transporting power.

Notwithstanding the evident recession of the brow of the upper cliff, there is no perceptible difference between the high-water line of the old and the new Ordnance maps. This may

be partly due to inaccuracy in the survey of 1838, or the operations for protection of the coast, although somewhat inadequate, may have retarded the waste, as far as is perceptible on the small-scale map, one inch to the mile. The difference indeed are chiefly in the opposite direction, that of increase of the land. Considerable areas are shown in the new map as enclosed from tidal access in the interesting area of Hamford or Hanford Water, west and northwest of the Naze. Some of these have since been regained by the sea, either through accident or neglect. But outside, and apart from human action, deposition has been proceeding, and the new map shows a projecting spit of sand (the Pye Sand), nearly a mile in length beyond the low-water line of 1838. This, coupled with the fact, informally mentioned by Mr. Mothersole at the excursion meeting, of the presence of quantities of Crag shells on the beach in that direction, far beyond the outcrop on the Naze, points to a northerly shore-current thereabouts, as a backward eddy from the general southward tendency, so fully evidenced at the groins and breakwaters along the Naze and towards Frinton. These are banked up to the top with sand on the north side, whilst to the south of each the bare London-clay forms a black slippery surface, full of water-holes.

Seawater, apart from its motive force, tends to preserve the London-clay, by excluding atmospheric air, and maintaining a state of saturation. It is the alternation of drought and wet that breaks up the fairly-solid clay, converting its abundant iron-pyrites into oxide of iron and free sulphuric acid, the latter in its turn attacking the carbonate of lime generally present. Both the ferric oxide and the sulphate of lime occupy greater bulk than in their previous combinations, apart from that of the carbonic acid gas set free by the later re-action. Some change possibly takes place also in the elements of the clay itself, for it passes from a rather tough mass, but one which will break into fragments, to a plastic dough, which can only be torn or squeezed apart. Perhaps in the absence of sufficient carbonate of lime, the sulphuric acid attacks the alumina of the clay, or the change may be purely molecular. At any rate, the modification proceeds inwards from every crevice, and each expansion produces further fissuring, until the mass, even at an early stage of the process, is traversed in every direction by cracks with slimy surfaces. A little excess of rain, and these surfaces are

forced apart by water making its way in by capillary attraction. Under such conditions, the whole becomes practically a viscous fluid, and cliffs or railway-cuttings are subject to perpetual slipping in greater or less degree. Every hillside of similar material is perennially on the down-grade from the same cause, and even gentle slopes have a like movement in minor measure. Expansion by moisture will be vertical only in absolutely level ground, where no cause exists for divergence to any side. If ever so slight a deviation from the vertical is possible, the expansion will be fractionally towards that side. Subsequent contraction will be truly vertical, unless a lower position is possible by a further lateral movement. On a cliff the action is more perceptible, because more rapid, and the prompt removal by the sea of whatever reaches the beach has induced the popular belief that the sea is the primary agent of destruction. Neptune has been blamed for what is mainly the action of Jupiter Pluvius. That Neptune assists in the spoliation cannot be denied, but he is accessory after the fact, the receiver of the proceeds.

In the later section of the day's operations, the *modus operandi* of these confederate powers was clearly demonstrated. The cliff-top between Walton and Frinton is practically a plateau, from which a covering sheet of gravel, probably of Post-Glacial date as at Clacton, has been but lately denuded, small patches of pebbles and sand being of frequent occurrence. The margin is indented into much the same form as that to which a child reduces a slice of bread-and-butter, a series of irregular, more or less circular scallops, with projecting points. At these salient angles, often very acute, the fall is nearly vertical; in the intervening recesses, a steep slope of a few yards generally reaches a ledge still covered with the original turf of the summit, and often fairly horizontal, but breaking into columns by intersecting cracks, as it passes by infinitesimal slips down the treacherous slope. Lower down a chaos of angular lumps of all sizes leads to the beach, interspersed with flows of viscid mud where surface waters seek exit through the obstructing masses. In every case the determining cause of the recess is seen to be one of the patches of residuary gravel already mentioned, its presence implying a slight hollow on the surface of the clay, and a collecting ground for the rainfall of the immediate vicinity. Near the edge, in every recess, new cracks show the initiation of a further loss. Where a continuous esplanade has been constructed, it

will require to be cleared from time to time, until the cliff reaches the angle of the slope compatible with permanent stability. But at the end of such artificial protection, Nature resumes her sway, eats into the undefended face, gets behind the masonry or concrete, and destroys it length by length. The only effectual system under the conditions is that of closely-set groins rising above springtide level, to accumulate sand and check the removal of slipped or solid clay. How far this may be regarded as a matter of imperial rather than of local interest and duty is a political question unsuited for discussion in these pages.

NOTES RELATING TO COAST EROSION IN ESSEX AND SUFFOLK.

EXTRACTED FROM THE REPORTS OF THE COMMITTEE OF THE BRITISH ASSOCIATION.

The Committee on Coast Erosion was appointed in 1881 at York. A preliminary Report was issued in 1884 and detailed reports appeared in 1885, 1886 and 1888. The final Report with summary of the evidence was issued in 1895. As these reports are somewhat scattered it may be well to summarise those relating to our coast, as an addendum to Mr. Dalton's remarks above. The somewhat crude diction arises from the notes being concise answers to a set of very definite questions.

In the second Report (*Brit. Ass. Rep.* 1886) Mr. John Bateman, of Brightlingsea, gave some evidence concerning the Estuary of the Colne, in which he stated the nature of the coast to be a fringe of flat salt-marshes overflowed at high tides. They form small cliffs of about 5 feet, and then soft mud reaches to low-water mark. There is no shingle. The coast-line is N.E. to S.W. and the prevailing wind is S.W. The E. wind is most important in raising high waves. The set of the tidal currents is the same as the mouth of the Thames. The coast is being worn back by the sea almost without exception from the mouth of the Thames northwards, and eastwards certainly at Mersea, Brightlingsea, St. Osyth, and Clacton. The cliffs only commence at Clacton. Questioned as to the rate of erosion he stated that the area of one salt-marsh of about 10 acres had diminished by nearly one-third in 20 years. The Tithe Commutation Map of Brightlingsea (1822?) shows "West Marsh Point" to have been something like 100 yards seawards of its present position. Land is being gained from the sea, and something like 700 acres of Brightlingsea were enclosed from the salt-marshes, 1700-1800. No record has been preserved of exact dates, but a map of 1780 shows much now

enclosed to have been then subject to occasional overflow. There are also curious isolated 'hills' of shingle and clay on some of the enclosed marshes, evidently washed together by sea action. 'Dunes' of blown sand fringe the coast of St. Osyth for 2½ miles, infringing perhaps 50 to 150 yards on the marshes; their height is 12 to 15 feet. He did not think that they were increasing and they are prevented from spreading landways by a long salt-water 'crick,' locally so-called, which runs close behind them inland.

In the same Report, Mr. Peter S. Bruff, M. Inst. C.E., gave evidence relating to the Suffolk and Essex coasts, from the river Deben to near the river Colne. He described the nature of the coast as varying—cliff, flat 'denes' and embanked marshes. The Cliffs are London Clay, sometimes capped with crag, gravel or sand; their greatest height above H.W.M. being 68 feet, and least 6 feet; an average of 37 feet. The coast-line lies N.E. to S.W. and the prevailing wind is S.E. to S.W. In raising high waves the most important wind is the N.E. to S.W.; in piling up shingle the most important wind varies locally from E. to W. (N. to W. at Walton). and in travelling of shingle the N.E. to E. is most efficient. The set of the tidal currents is N.E. to S.W. The range of tide in vertical feet at springs is 11 ft. 6 in., and at neaps, 8 feet. The width of spring tide between high and low water is from the Deben to the Orwell 25 yards, at Walton-on-Naze 230 yards, and at Clacton 150 yards. From the Deben to the Orwell the area covered by the tide consists of sand and shingle with occasional layers of cement stone at the foot of the beach. From the Orwell to the Colne there is a clay flat at foot of the beach uncovered at low water. The shingle is about 30 to 40 yards broad at Felixstowe and Clacton. With respect to the tide mark it is sometimes evenly distributed, and sometimes in patches with sand between, and it travels from N.E. to S.W. A small proportion of the pebbles are as large as hens' eggs, the majority much less. A ridge of shingle is formed by the spring and neap tides, the height above the respective tide marks varying according to the state of the wind. The average height would be about 2 feet above the tide marks Where not protected by groynes the shingle is diminishing, by natural causes. The groynes of timber-piles and planks are 30 or 40 yards long, generally at right angles to the shore line, at varying distances apart, and of very diverse heights; there are some stone ones at Walton-on-Naze. Between the Deben and the Orwell, they arrest the shingle very effectually, and prevent the loss of foreshore and land. At Walton the same is true in a less degree. A considerable quantity of shingle has been taken from the beach at Clacton at about high-water mark, for road-making and for concrete for building. It is said that some 40 or 50 years ago cement stone was dredged and otherwise removed in front of Felixstowe, which removal had an injurious effect upon the coast, but the practice has long been discontinued. The coast is being worn back by the sea at Felixstowe, between the 'Lodge Point' and Martello Tower P., and also at Walton and Frinton. At Felixstowe the greatest loss was where there was 'flat ('Benthill') at the foot of cliffs. At Walton and Frinton there are London Clay cliffs 40 to 68 feet above high water. At places as much as 100 feet is lost by erosion in 10 years, but a fair average would be about half that amount. The loss at Felixstowe is practically stopped by the groynes on the beach For data, the Tithe-maps of the parishes in question may be compared

with the $\frac{1}{2500}$ Ordnance Survey Maps of 1874. At Walton and Frinton the loss is practically confined to areas bare of shingle. The existence in the cliffs of potholes of sand and gravel containing water is also a cause of subsidence; the water breaking out on the base, carrying the sand with it, loosens large masses of the upper part of the cliff. The loss of land at Walton and Frinton has gone on from time immemorial:[1] but it has been noticed that since the construction of the Harwich Harbour Conservative Board's Works at Landguard Point there has been a greater scarcity of shingle on the beach at Walton and Frinton. Part of Landguard Common and the land at the mouth of the Deben is formed of 'blown sand' (locally called 'Benthills') covering the top of a shingle beach, their height being from 3 to 10 feet above high water-mark. The Benthill at Landguard Point is increasing in consequence of the Conservancy Board's jetty. The sand is not blown over the land, this being prevented by the 'bent grass' or 'marram.' With his report Mr. Bruff presented tracings showing the Harwich Harbour Conservancy Board's Works at the entrance to the harbour, and the scouring away to Landguard Point to the S.W., and accumulation of beach to the N.E. of the same. And he referred to the various reports presented to and published by the authority of Parliament.

In the same report Mr. W. Teasdell, C.E., stated that at Gorleston Suffolk, the cliff had gone back from 200 to 300 feet within the last 40 years, within the last 6 years, 60 feet; the cliffs are sand 80 to 90 feet high.

At the British Association meeting for 1895 (*B.A. Rep.* p 678) our member, Mr. John Spiller, F.C.S., furnished some details on "Recent Coast Erosion at Southwold and Covehithe," Suffolk. The report was published in full in the Supplement to the *East Anglian Daily Times*, Sept. 13th, 1895, but the following abstract will be sufficient for the present purpose:—

"Owing to the prevalence of northerly winds, culminating in a moderate gale on May 16th (1895) the tide rose to an unusual height all along the East Coast, and attacked the soft sandy cliffs between Dunwich and Covehithe, creating a new cove at the northern extremity of Southwold, and sweeping away the roadway at the back of the beach to the extent of half an acre at this particular spot. The Cliffs at Eastern Bavents and Covehithe likewise suffered considerably, and this loss being reported to Mr. W. Whitaker induced that gentleman to lend his maps with certain measurements noted thereon for the purpose of exact comparison. Thus provided, the author walked over the ground and took fresh measurements at the several points along the route, which resulted in the determination of the amount of cliff-waste since 1882 and 1889, and this, stated briefly, was as follows;—

1 At a Local Government Board enquiry with regard to the Frinton Council's application for leave to borrow £1,760 for sea defences and cliff preservation, held on October 31st, 1902, it was stated that the encroachment of the sea at Frinton during the last 50 years had been very severe. Sixty yards of cliff had been lost since 1874. This was at the rate of about 10 feet per annum. Near the eastern extremity of the parish there was an old stone groyne where a large bed of sand had accumulated, and damage done to the cliffs there had been checked to a large extent.

	feet.
Easton Bavents, loss in 6 years	20
Easton High Cliff, „ 13 „	22
Covehithe Cliff, „ 6 „	84

The accuracy of these observations was checked by Mr. Horace B Woodward, and other indications observed conjointly proved that the general loss at Covehithe amounted to about 50 yards since the present Ordnance map was constructed. The lines of high and low water mark had manifestly altered, so that a fresh survey was necessary.

A discussion on Coast Erosion took place at the Conference of Delegates of the Corresponding Societies during the Bristol meeting of the British Association in 1898. The labours of the Coast Erosion Committee were then at an end. A chief result of this discussion was an application to the Admiralty, which has since secured the co-operation of the Coast Guard in noting the changes on our coast. One speaker, Mr. W. H. Wheeler, who had paid much attention to the subject, then remarked that the retention of a considerable mass of shingle in front of a place would furnish a better protection than a sea-wall. As to the cause of the travelling of shingle along the shore in a definite direction, Mr. Wheeler, in a paper read to Section C. at the same meeting, said "that the travel of shingle is not coincident either with the prevailing or predominant winds, but on a tidal coast the predominant drift is invariably in the same direction as that of the flood tide." (*Report* 1898 p. 884.) North of the estuary of the Thames the shingle travels from the north southward; south of the estuary it travels from the south northward.

It should be added that the Reports above alluded to contain a Bibliography of the subject up to the year 1895.

ADDITIONAL NOTES ON THE SECTIONS SHOWN AT THE NEW RESERVOIRS IN THE VALLEY OF THE LEA, NEAR WALTHAMSTOW.

EVIDENCE OF THE PUDDLE-TRENCHES.

By T. V. HOLMES, F.G.S., F. Anthrop. Inst., *Vice-President, E.F.C.*

While the sections afforded by the excavations for the new reservoirs have been of the highest interest in their display of the various changes in the details of the river deposits, they have

given very little information as to the varying depths at which the London-clay was reached beneath the river deposits.[1] It is true that here and there at the bottom of the excavations the top of the London-clay was either visible, or the presence of fragments of septaria nodules in the gravel suggested the nearness of the clay. But, as we shall see, the general impression derived from visits to the reservoir excavations, as to the depth of the London-clay, needs correction from the additional evidence obtained during the construction of the puddle-trenches in the centre of the boundary banks.

I am greatly indebted to Messrs. Sharrock and Spencer, the engineers representing Messrs. Pearson, the contractors, for information as to the strata met with in the puddle-trenches, of which they have preserved a most careful account. But I do not propose here to touch upon the details of the river-deposits, or even to note minutely the varying depths at which the London-clay, was found in the puddle-trenches, my object being simply to give the distribution of the depths which are within normal limits and of those which are beyond them.

In the first place, it seems desirable for the sake of comparison, to note at what depths the London-clay has been touched beneath the river deposits of the Lea Valley outside the new reservoirs but within a short distance of them. On consulting Mr. Whitaker's Geological Survey Memoir on *The Geology of London and of Part of the Thames Valley* (vol. 2) we learn that at Waltham Abbey the East London Water Company in their well close to Waltham Lock, found 18 ft. of river deposits above the London-clay, at Walthamstow Marsh 17½ ft., at Chingford Mill 10 ft., and at Longwater Pumping Station, Tottenham, 20 ft. at one spot and 16 ft. 100 yards away. And the records of borings and sinkings through the somewhat older river deposits of Tottenham and Edmonton nowhere show them to be more than 21 ft. thick. But as they are few and scattered over a large area, they do not necessarily preclude the existence of spots between them which might give a different result.

Dr. Henry Woodward, F.R.S., in his paper on "The Ancient Fauna of Essex" (*Trans. Essex Field Club, vol. iii.*, pp. 1-29, 1882-3) gives an account of the sections exposed during the construction of the reservoirs of the East London Water

1 T. V. Holmes "Geological Notes on the New Reservoirs in the valley of the Lea, near Walthamstow," *ante* pp. 1-16.

Company at Walthamstow in 1868-69, south of those now being made. The sections in the river deposits of Walthamstow Marshes, closely resembled, as might be expected, those within the newer and more northerly reservoirs. And Dr. Woodward adds, that while the depth of the general floor within the reservoirs nowhere exceeded 10 feet, "the trenches made for the 'puddled walls' in the centre of the artificial embankments went down to a depth of 20 to 24 ft."

The details preserved by Messrs. Sharrock and Spencer show a very much greater amount of variation as to the depth of the London-clay beneath the river deposits in the new reservoirs, than has been met with elsewhere in the district. At the neighbouring spots already mentioned the depth varied from 10 to 24 ft. In the more northerly of the new reservoirs, the "Banbury Reservoir," the London-clay was generally reached in the puddle-trench on its eastern border (near the edge of the marsh) at depths of from eight to nine feet. At other parts of the reservoir boundary the depth was greater, the variations being, however, very gradual, and the greatest depth reached being 26 ft. at the most westerly point of the reservoir, a few yards due east of the rifle butts. In the boundary bank of the southern, or Lockwood, reservoir the variations were much greater and more sudden. Starting from its southern end, I was informed that a few yards west of the old channel of the Lea,[2] London-clay was found at a depth of 13 ft., and at 25 ft. at a similar distance east of it. Proceeding in a northerly direction, along the western side, as far as Stonebridge Lock, the greatest depth was 23 ft. and was met with close to the Lock. Along the eastern side London-clay was deepest at a point about due west of the northern end of "Low Maynard Reservoir," being there 36 ft. below the surface. The average on the eastern side was from 20 to 25 ft., or very nearly the same as that of the western side from Stonebridge Lock southward. But on the western side, from Stonebridge Lock to the north-western end of the reservoir, the London-clay gradually becomes deeper, and was found to be, at the north-western corner, 57 ft. below the surface of the marsh. Then, 60 or 70 yards east of that point, in the northern boundary, the clay was only 15 ft. below.

2 See Map, ESSEX NATURALIST, vol. xii., p. 2 (1901).

Thus it appears that the average depth from the surface of the London-clay, in the puddle-trenches of the new reservoirs, is about 18 ft., and that its normal variations are from 9 to 10 ft. on the one hand to about 25 ft. on the other. And this result coincides with that obtainable either from Dr. Woodward's remarks on the puddle-trenches of the more southern reservoirs, or from the sinkings and borings given in Mr. Whitaker's *Memoir*. Thus, while in the boundary of the Banbury reservoir the London-clay cannot be considered to be at an abnormal depth anywhere, in the "Lockwood Reservoir" it appears to be abnormally deep at its north-western corner, where it is 57 ft., and on its eastern side, close to the northern end of the "Low Maynard Reservoir," where it is 36 ft. below the surface. And a line drawn across the reservoir through these two spots would doubtless mark the position of the narrow subterranean hollow in the London-clay which may, or may not, attain its greatest depth at the north-western corner. A continuation of this line northward would bring it to a point a little westward of the most westerly point in the northern reservoir where, as we have seen, the London-clay was deeper than at any other spot in its boundary bank.

I am informed that where the thickness of the beds above the London-clay was greatest, in this depression, the material composing them consisted of gravel, sand and silt, much resembling that of the river deposits elsewhere. And the direction of the narrow line of depression seems to be nearly due north and south, or very slightly west of south and east of north. But whether the somewhat unusual depth of 26 feet, at which the London-clay was found at the western end of the Banbury reservoir, indicates the nearness of a more noteworthy depression beneath the Rifle Butts, we have no evidence to determine.

The paper "On a Deep Channel of Drift in the Valley of the Cam, Essex," by Mr. W. Whitaker,[3] appears to me to describe some drift-filled hollows which are all akin to that beneath Lockwood reservoir, while one example has a specially strong resemblance to it. Mr. Whitaker gives details of wells at Quendon and Rickling, Newport and Wendon, which all show a very great and wholly unexpected thickness of the Glacial-gravel and sand, which underlies the Boulder-clay,

3 *Q. J. Geol. Soc.*, vol. lxvi., p. 333 (1890). ESSEX NATURALIST, vol. iii., p. 140 (1889).

resting in hollows on the Chalk. In one case at Newport, a boring for a well for the Grammar School was begun in the Glacial-gravel and sand. Instead, however, of the slight thickness expected, "the boring tool, after passing to a depth of 340 feet, chiefly through loamy beds, did not succeed in reaching the chalk, and the work was abandoned. The drift, therefore, must here go down to a depth of about 140 feet below the level of the sea, how much deeper we know not."

But the drift-filled channel which most perfectly resembled that at "Lockwood Reservoir" is the one described by Mr. Whitaker at Littlebury, a little more than a mile north-west of Saffron Walden. There the valley of the Cam is cut in the Chalk, and the Glacial Drift is to all appearance confined to the high ground east and west of the river valley, which ranges north and south. At the bottom of the valley are some River Gravel and Alluvium, the village of Littlebury standing mainly on the gravel, which is west of the stream. In five wells the depth to the Chalk varied from 3 to 6 feet only. In two other wells it was 15 feet from the surface; while a third well ended in sand at a depth of 22 feet. These wells are scattered through the village. But near the centre of the village, and only a few yards more easterly than the wells mentioned, a boring 218 feet deep did not touch the Chalk, the whole of the material pierced through being Drift. The length of this channel is doubtful, but its direction is evidently that of the river valley, where the surface is occupied by river-deposits, just as in the case of the channel beneath the Lockwood reservoir.

As regards the nature of this deep channel in the Chalk, Mr. Whitaker reviews the various explanations that suggest themselves. These are, he says, "disturbance, sinking in of the Chalk, and erosion." He dismisses, as extremely unlikely, the idea of a fault, or that the gravel has filled in a hollow caused by the local dissolution of the Chalk by chemical action, though he admits that it may have deepened a hollow formed in some other way, and decides that erosion of some kind must have been the agent. And that the channel must have been cut before the deposition of the Boulder clay on the higher ground on each side of the river valley, in either Pre-Glacial or early Glacial times.

It appears to me that in the channel under the "Lockwood Reservoir" we have, in all probability, one of the same kind,

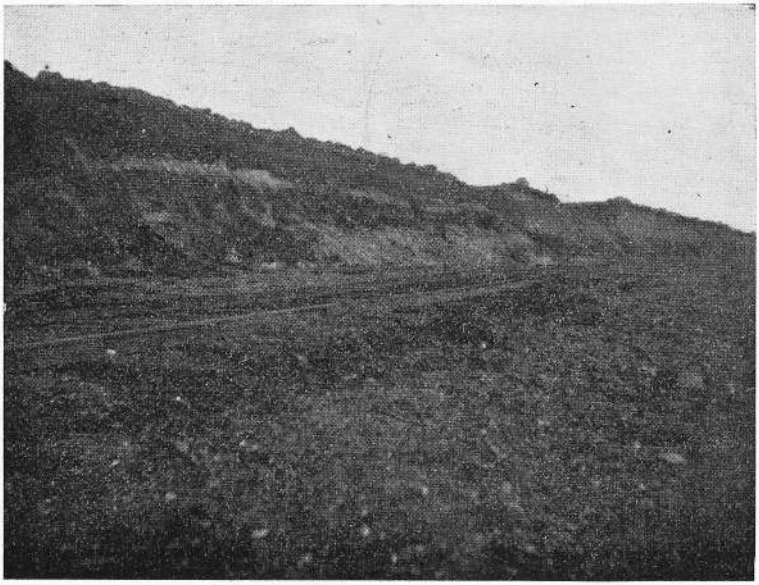
and one also the result of erosion in either Pre-Glacial or early Glacial times. In this case in the valley of the Lea there is quite as strong a probability against the agency of a fault as in that at Littlebury; while local chemical dissolution, which formed a possible cause on the Cam, either of making or deepening the channel, is out of the question with the London-clay of the Lea.

I have already remarked that at Littlebury glacial deposits are seen only on the high ground east and west of the river valley, Boulder-clay alone having been noted there. But at Newport, also on the Cam, and about three miles southward, the Glacial sand and gravel is found in the sides of the valley between the river-deposit at the bottom and the Boulder-clay above. In the valley of the Stort this is the case everywhere from its source to its junction with the Lea at Hoddesdon. From Hoddesdon southward the Glacial Drift, whether gravel or Boulder-clay, or both, is seen only on the high ground at some distance from the river. But both on the eastern and western sides of the Lea it has been noted as far south as Hendon, Finchley and Muswell Hill in Middlesex, and Woodford and Romford in Essex.[4] So that there can scarcely be any doubt as to the Post-Glacial age of the valleys of the Cam about Littlebury and the Lea at Tottenham and Walthamstow. Of course I use the word Post-Glacial in its only legitimate sense as meaning of later date than the Chalky Boulder-clay of Essex and Middlesex.

In the north of England, as Topley remarked in the discussion on Mr. Whitaker's paper, many examples are known of the Pre-Glacial and Post-Glacial valleys of rivers and the relations between them. In illustration he stated that in Northumberland the Blyth was in Pre-Glacial times a tributary of the Wansbeck, and a deep Pre-Glacial valley, which was filled with Glacial Drift, occurred between the present valleys. Many other cases might be mentioned in which the Pre-Glacial drainage system, having been in its general features like that of Post-Glacial times, the river valleys in the two periods have here and there coincided. In this part of the south-east of England the Glacial deposits have covered the Pre-Glacial

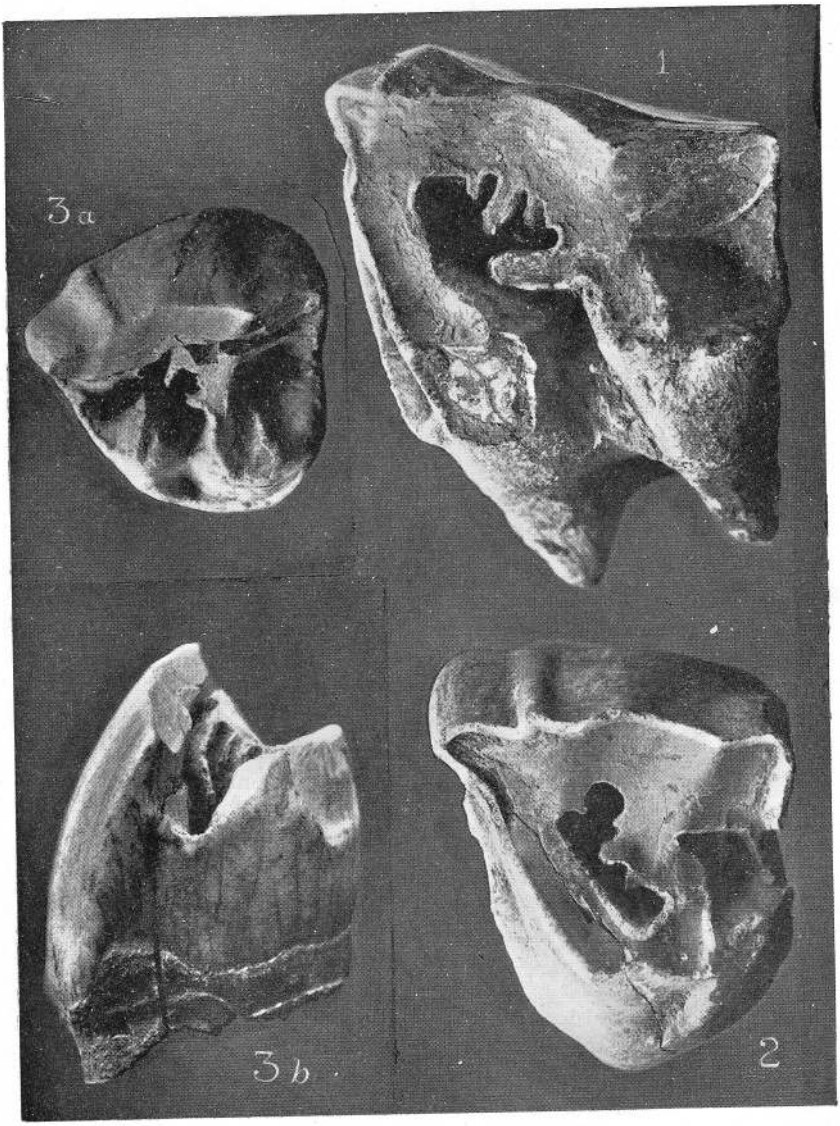
4 *Q. J. Geol. Soc.*, vol. lxviii., p. 365 (1892); *Q. J. G. S.*, vol. l., p. 443 (1894). Also ESSEX NATURALIST. vol vii. (1893).

plateaux and at the same time filled up more or less completely the Pre-Glacial valleys. In the Boulder-clay at Hornchurch near Romford, about 100 feet below its usual level, thereabouts, yet covered by some of the oldest gravel of the present Thames there is a certain approximation to coincidence, in the valleys of the two periods. Where Post-Glacial drainage has taken a new course, the position of an old Pre-Glacial valley may remain unsuspected but for a well boring, as at Newport Grammar School. Where there is a local coincidence between the Pre-Glacial and



Post-Glacial valleys, there we may find a fragment of a Pre-Glacial channel filled with material of Glacial age beneath river-deposits of later date, as at Littlebury and the Lockwood Reservoir. But of course both channels alike suggest that during their formation the whole country stood at a much higher level above the sea than it now does. For in each case the bottom of the channel is below the present level of the sea.

The photograph is one taken by Mr. F. Meeson during the visit of the Geologists' Association in April, 1901. The spectator is looking southward, and the view gives the section across two



TEETH OF RHINOCEROS, FROM ILFORD, ESSEX.

old channels in the "Lockwood Reservoir," the more northerly of which is shown in Fig. 5, p. 8, ESSEX NATURALIST, vol. xii. In spite of its small scale, the photograph illustrates the disappearance of the peat bed close to the old channels and its replacement there by sand and gravel. The section has now disappeared.

ON SOME TEETH OF RHINOCEROS FROM ILFORD, ESSEX.

WITH REMARKS ON THE DISTRIBUTION OF RHINOCEROS IN THE THAMES VALLEY DEPOSITS.

By MARTIN A. C. HINTON.

[*With Plate X.*]

During the course of the last six years I have had occasion to examine many of the vertebrate remains which have been obtained from the Pleistocene deposits of Ilford, Essex. These specimens include among them a large series of the molar teeth of *Rhinoceros*, referable for the most part to the species named *R. hemitœchus*, Falconer (=*R. leptorhinus*, Owen). Some of these teeth appear to me to be of such interest and importance as to merit being described and placed on record, and they form the subject of this communication.

The first specimens to be described are three upper molars in my own collection which were obtained from the Cauliflower Brickyard in 1897. One of these is a penultimate premolar of the left side; it is somewhat damaged, the external lamina of the outer wall being lost. The posterior valley is just isolated into a reniformly triangular fossette. The transverse valley is just on the verge of isolation, but whether this had been actually accomplished or not cannot be ascertained as the inner wall of the tooth is somewhat mutilated. The crochet is strongly bifid, projecting a little more than halfway across the valley. The outer wall gives off *three* combing plates all more or less parallel with the crochet and one only of which has been touched by wear. Remains of a thick coat of cement are seen on this specimen.

The next specimen (fig. 1, plate x.) is a finely preserved second true molar of the left upper jaw. In this the posterior valley is still intact. The crochet is emitted at a right angle

from the anterior wall of the hind barrel and is closely approximated to the hind wall of the front colline, which it does not quite touch. From the middle of the outer wall no fewer than *four* combing plates project, the penultimate of which, counting from the crochet, is large and massive. The form of the crochet is more or less rectangular and the combing plates are disposed in the same general direction with it. There is a very thick coat of cement on the lower portion of the crown. The dimensions of this tooth are :—

Greatest antero-posterior length of external wall	..	2·38 inches
Antero-transverse width (at base of crown)	..	2·5 ,,
Postero-transverse width (at base of crown)	..	2·14 ,,

The third specimen is a last true molar of the left upper jaw and is, unfortunately, badly damaged. Notwithstanding this mutilation, however, it is of considerable interest. The crochet is given off at a comparately open angle and bends flexuously as it juts into the transverse valley ending off very near the anterior barrel in a sharp edge. The outer wall gives off *three* combing plates which all trend more or less in the same general direction as the crochet though they converge somewhat towards it. The valley is still further complicated above the crochet by a process which projects into it from the anterior barrel evidently resembling in this respect the tooth from Grays Thurrock described by Dr. Falconer (*Palæontological Memoirs*, vol. ii., p. 336). On various portions of the crown remains of a thick coat of cement may be seen.

From the great complication of the transverse valley in each of these three teeth, from their relative states of wear and from the similarity of their appearance, I consider them as belonging to one individual. From the form of the crochet in the premolar and the second true molar, the direction of the combing plates, and from the circumstance of the thick coat of cement which is seen on all of them I have referred these teeth to the *R. hemitoechus*, Falconer. They are cited here because of the extreme complication of the transverse valley of which they afford a fine illustration and which is characteristic of many of the teeth of this species from Ilford.

The specimen described next was submitted to me for identification by Mr. G. White who obtained it with others from one of the pits on the Uphall Estate, the sections and fossil contents of which have lately been described in the admirable

papers by himself and Mr. J. P. Johnson which have appeared in the ESSEX NATURALIST. It is a detached fourth premolar of the left upper jaw. The transverse valley is completely isolated through wear and into it, from the posterior barrel, is projected a strongly developed bifid crochet. The outer wall gives off two very small combing plates, one of which is parallel to and just above the bifid crochet. The other is given off in a line with the anterior external angle of the tooth, converging towards the first and the crochet at a right angle. The posterior valley is not yet isolated, and the cap of enamel which arises from its inner wall, and which passes over the hind barrel and so into the inner wall of the tooth is still in great measure intact (fig. 2). There is a well marked basal bourrelet passing right round the anterior barrel. This starts from near the grinding surface a little inwards from the anterior angle; from this point it gradually sinks until the inner extremity of the anterior barrel is reached, from whence it rapidly rises up again ending off at the inner and forward rim of the enamel cap before spoken of. The dimensions of this tooth are :—

Antero-posterior length measured along outer surface at base	..	1·7 inches
,, ,, ,, inner ,,	..	1·25 ,,
Antero-transverse width at base	..	2·47 ,,
Postero- ,, ,, ,, ...	..	2·2 ,,
Height of crown at junction of anterior and posterior barrels	..	1·4 ,,
,, ,, anterior outer angle	..	1·88 ,,

I have referred this specimen to *R. leptorhinus*, Cuvier, *pro parte* (=*R. megarhinus*, De Christol). The point to which I wish to direct special attention is the remarkable state of wear and the figure will give a much better idea of the characters described here than any mere verbal description. In all known species of *Rhinoceros*, either fossil or recent, the small posterior valley is the first to be isolated into a fossette by the detrition of the tooth. This arises from the fact that while the entrance to the posterior valley is comparatively shallow, not cutting deeply into the body of the tooth, being from this cause soon obliterated, the entrance to the transverse valley forms a much deeper cleft separating the barrels and consequently remaining for a proportionally longer period intact. But in this specimen it is the transverse valley which has been isolated first, the posterior valley having its entrance still intact though cutting into the tooth no deeper than usual. This malformation appears to me

to be of great interest, the only other instance of which I am aware occurring in a fourth premolar of the upper jaw which Dr. Falconer referred to *R. etruscus* and which is figured in the *Palæontological Memoirs*, vol. ii., Pl. xxv., fig. 6. This latter specimen is from one of the Italian Pliocene deposits and is now preserved in the museum at Pisa.

The next specimen to be noticed was also obtained by Mr. G. White from one of the Uphall sections. This is a slightly worn penultimate molar of the left upper jaw. The crochet is thin and wedge shaped and is projected well across the transverse valley. The external wall gives off a large combing plate converging at a right angle towards the crochet, while just above the latter from the anterior barrel projects another little combing process. The large combing plate is placed nearly diagonally to the anterior outer angle of the tooth. The barrels have their apices compressed and somewhat twisted, making the entrance to the transverse valley appear very wide. There is a small prominent tubercle in the entrance of the latter between the barrels. The dimensions of this tooth are:—

Antero-posterior length (external) of crown	..	3·0 inches
Antero-transverse width, at base ..	..	2·5 ,,
Postero-transverse width, at base ..	..	1·9 ,,

This specimen is very characteristic of the *R. leptorhinus* Cuvier, *pro parte*, to which species I have referred it.

In the collection of Dr. Frank Corner, F.G.S., there is a fine first upper true molar of the left side obtained by him from the Cauliflower Brickyard. This has the crochet thin and wedge shaped, and given off at a somewhat acute angle. A small combing plate is projected from the external lamina in a line with the antero-external angle. The posterior valley of the tooth is still intact. The anterior colline is large and shows the apical contortion characteristic of the species to which I have referred it. There is a well marked emarginate bourrelet passing round the base of the front colline. The posterior barrel or colline is broken, but shows apical contortion in section. The enamel is smooth, with a rather thick coat of cement upon the lower part of the sides of the crown. The dimensions of this tooth taken at the base of the crown are :—

Antero-posterior length (externally)	..	2·49 inches
Antero-transverse width ..	..	2·66 ,,
Postero-transvere width ..	..	2·05 ,,

This tooth I have referred to *R. leptorhinus*, Cuvier, *pro parte*, of which it is very typical. It is the only example of this species that I am acquainted with from the Cauliflower Brick-yard.

The last specimen I have to notice is in the collection of Mr. J. P. Johnson who obtained it with others from the Uphall section (Figs. 3 and 3a). This is a fine and slightly worn ante-penultimate premolar of the left upper jaw. Its large size would seem to indicate the *p.m.* 3 rather than the *p.m.* 2, but that it is the latter is perfectly clear from the sub-triangular form of the crown, the form of the anterior colline, and the absence of a pressure scar in front. The latter character proves that there was no first premolar in this individual. The anterior colline is seen to form a completely isolated conical cusp exactly as in the specimen figured by De Christol in his memoir in the *Ann. des Sciences Nat. Zool.*, ser. 2^{me}, vol. iv., pl. 3, fig. 12. The apex of this cusp is worn off, a small elliptical disk of wear being the result. Figures 3 and 3a will give a much better idea of this specimen than any description. It is referred to the *R. leptorhinus*, Cuvier, *pro parte*, of which species it is very characteristic. Subjoined are the dimensions of this specimen together with some corresponding ones given by Falconer of this species and by Dawkins of the homologous tooth in *R. hemitoechus*, Falconer.

P.m. 2 *R. leptorhinus*, Cuvier *pro parte*. (=*R. megarhinus*, De Christol).

	Ilford.	Falconer *op. cit.*
Antero-posterior length ..	1·6 in.	1·55 in., 1·45 in., 1·95 in., 1·55 in.
Greatest-transverse width..	1·76 ,,	1·70 in., 1·60 in., 1·70 in., 1·60 in.

P.m .2 *R. hemitoechus*, Falconer (=*R. leptorhinus*, Owen), Dawkins, (*Q.J.G.S.*, vol. xxiii., p. 213).

Antero-posterior length ..	1·15 inches ..	1·15 inches.
Greatest-transverse width ..	1·40 ,, ..	1·28 ,,

The distribution of the species of *Rhinoceros* in the Middle-Terrace deposits of the Thames Valley below London is of considerable interest. At Ilford *R. hemioetchus* is by far the commonest form; remains of *R. leptorhinus* occur in fewer numbers but still fairly abundantly, while *R. antiquitatis* is of very rare occurrence. At Grays Thurrock *R. leptorhinus* ranks first in abundance, *R. hemitoechus* being the rarer; and *R. antiquitatis* not known from this locality. At Crayford and Erith on the other hand the commonest remains are those of *R. antiquitatis*,

the other two species occurring but very rarely. In this connection it is of interest to note that in the case of Ilford the remains of the prevalent species of *Rhinoceros* exhibit a tendency to vary towards the prevalent species occurring at Grays Thurrock in the greater complication of the transverse valley of the molars by combing plates—a character much more common in *R. leptorhinus* (the Grays form) than in *R. hemitoechus*. A precisely analogous instance is presented in the relationship between the Elephant remains found in the deposits of the two localities. At Ilford *Elephas primigenius* is the common form, while at Grays Thurrock this position is held by *E. antiquus*. But many of the molars from Ilford of the Mammoth depart from the typical form of that species and by having plates of thicker enamel, more or less complicated by crimping, they approach in appearance what is seen in *E. antiquus*.

In the present state of our knowledge, no conclusions can be with safety drawn from these facts of distribution. They, in common with many other ascertained facts of Pleistocene Geology and Palæontology, indicate important portions of the history of the Thames Valley, but these portions we cannot read until we have been able to appreciate many factors which as yet are but little understood.

In conclusion I have to express my best thanks to the gentlemen mentioned in this paper for the loan of their specimens and my warmest gratitude to Mr. F. W. Reader for his kindness in preparing the admirable figures in the accompanying plate.

THE TWO FORMS OF THE SEA-ASTER (ASTER TRIPOLIUM).

By PERCY CLARK, B.A.

As I now write (September 6th, 1901) the Essex Salt-marshes, bordering the sea, which are overflowed by the water at springtides, present a beautiful appearance. The tall upstanding masses of the Sea-Aster growing there in wild and unchecked profusion, are all in flower, and their small golden heads massed together in thousands shed a glow of soft yellow colour over the Saltings. But a few paces inland where the

same plant grows on the side of dried up ditches or on low banks, they possess a ray (absent in the former) of delicate lavender florets surrounding a yellow centre, which clothes them in an entirely different aspect.

Has any one remarked on this peculiarity before? I do not find it noted in my hand-book. I closely examined the marine plants and found in many cases a few poorly developed lavender ray-florets growing unevenly here and there, but the majority had none at all, and the few that produced them looked as if they were half ashamed of owning such shabby productions. Yet just over the sea wall, where the tide could not penetrate, the lavender or purple rays were in full bloom, and conspicuous by their strong and healthy condition. Is it a case of degeneration? Can it be that the sea-aster thriving on the soft luscious mud of the saltings, has found such a luxuriant habitat that it troubles no longer to produce the beautifully tinted ray-florets which erst were probably intended to attract the helpful bee or other winged insect?

In the present crowded state of the plants, would the wind be a sufficient carrier of pollen? They certainly show a very marked variation in accordance with habitat. It has at first sight the look of a clear case of either evolution or devolution, and I should be glad of an opinion, if I can elicit such, in the pages of the ESSEX NATURALIST.

[The two forms of the Sea-Aster are, of course, well-known, the rayles or generally nearly rayless, one being separated as var. *discoideus*, but I have been unable to find that anyone has before connected the forms with a difference in habitat. When I received Mr. Clark's interesting notes last year, it was too late to test the suspicion that possibly there was a young and an older form of the flower, and that the latter had shed the ray-florets. I therefore, with Mr. Clark's approval, kept the note back. Whilst on the Essex Coast this August and September I paid attention to the asters, and I can certainly confirm Mr. Clark's observations. I observed very many thousand plants growing on the mud bordering the estuaries and creeks, and in the vast majority the purple "rays" were absent in all stages—the imperfectly rayed plants noticed were only a very small percentage of the wholly rayless form. At the same times, the asters growing on the higher tideless lands in St. Osyth parish and elsewhere, were conspicuously attired with beautiful purple, or whitish purple, rays. Diptera and Hymenoptera frequent both forms—but in my experience are in far greater profusion on the "rayed" asters.—W. COLE.]

MUSEUM NOTES No. IV.

VIII.—ADDITIONAL OBJECTS FROM THE ROMANO-BRITISH SETTLEMENT AT CHIGWELL, ESSEX.

Very many of our readers are acquainted with the interesting series of objects so admirably arranged and exhibited by Mr. I. Chalkley Gould in the Epping Forest Museum, and with the little "Handbook" which he prepared in explanation thereof.[1] At the Meeting of the Club on January 25th, 1902, Mr. Gould showed some specimens which had recently been discovered at the site, and made some remarks on the same, which are embodied in the following notes. Most of the objects have been added to the series in the Museum:—

"I exhibit a few coins and some fragments of 'Samian' and other pottery from the Chigwell Settlement. Though mostly in poor condition the coins are of value to us, being approximately indicative of the period of occupation of the site; at the same time it must not be forgotten that Roman coins circulated for ages after the death of the rulers whose superscription they bore.[2]

"Most of the coins hitherto found at Chigwell have suffered so much decay as to render identification impossible, but those shown exhibit sufficiently distinguishing impressions, while a few are in very good condition.

"They consist of the following specimens:—

NERVA (Silver). Bust facing to right.[3]
(*A.D.* 96-98) *Inscription.* IMP. NERVA CAES AUG PM TR P COS ii COS iii PP
Reverse. Two hands joined. CONCORDIA EXERCITUUM

HADRIAN (Brass). Bust facing to right
(*A.D.* 117-138) *Inscription.* Gone.
Reverse. Two figures and an altar. Almost undecipherable.

1 *Notes on the Romano-British Settlement at Chigwell, Essex, &c.* Essex Field Club *Museum Handbooks, No* 2, 1895. Price 3½d. post free.

2 In his book *Le Tombeau de Childeric I.* L'abbe Cochet relates that Roman coins circulated in some country districts of France (even down to 1853) where such pieces were known as *sous à La Vierge.* They appear frequently to have found their way into the church offertories, enabling clergy and sacristans to make respectable collections of such coins!

3 This coin is kindly lent by Mr. W. Daniels of Chigwell, the others belong to the writer. —I. C. G.

ANTONINUS (Brass). Bust facing to right.
(*A.D.* 138-161) *Inscription.* Gone.
Reverse. Figure holding a sceptre in one hand, a cap in the other. S.C. COS IIII. This coin was issued in A.D. 154.

ANTONINUS (Brass). Bust facing to right. Head is in good condition.
Inscription. Gone. Should read IMP. CAES. T. AEL HADR. ANTONINUS AUG PIUS PP.
Reverse. Figure of Concord looking to left holding two military ensigns TR. POT XXII. COS IIII SC

ANTONINUS (Silver). Bust of Antonine facing to right. ANTONINUS AUG PIUS PP TR P COS III.
& **AURELIUS** *Reverse.* Bust of M. Aurelius facing to right. AURELIUS CAESAR AUG P II F COS (Antonine made Aurelius his consort in ruling the Empire).
A.D. 161-180)

LUCILLA (Brass). Bust facing to right. LUCILLA AUGUSTA.
(*m. A.D.* 164) *Reverse.* Female figure seated, a young boy on her knees, young girl before her and another boy behind. FECUNDITAS S.C. (Lucilla was married to Lucius Verus A.D. 164).

CARACALLA (Brass). Bust facing to right.
(*A.D.* 211-217) *Inscription.* Gone, and reverse totally destroyed.

CONSTANTINE (Brass). Armoured head facing to left.
(*A.D.* 306-337) *Inscription.* Gone.
Reverse. Wolf suckling the twins. This coin was issued A.D. 327 to 330. A broken, mutilated specimen.

"The pottery is selected from a bushel or two of potsherds recently excavated in digging brickearth—the pieces are of little importance in themselves but are of interest to us from the position of the discovery, being a little further N. and N.W. than the site of former finds, showing the still greater extent of the village. Those who are familiar with the plan in the handbook, descriptive of my collection on view in the Forest Museum, will remember that a considerable area is shaded to indicate the pottery-yielding ground; the recent discoveries would somewhat extend that shading, in the directions mentioned.

"Another point of interest must be noted. Most of the more or less perfect vases and urns in the Forest Museum came from the more southern portion of the area (formerly excavated for gravel). Those were usually associated with undoubted evidence of cremation; we were then upon the cemetery or

burial ground of the settlement, but the more recent finds, resulting from excavations further north, are not so associated but are found in pockets (or small pot-holes) or scattered broadcast without surroundings of black earth or burnt material.

"We have in fact passed from the habitations of the dead to the land of the living, who occupied this unknown, unnamed settlement in the Roding Valley."

I. CHALKLEY GOULD.

THE LIBRARY TABLE.

The Elements of Agricultural Geology: A Scientific aid to Practical Farming. *By Primrose McConnell, B.Sc., F.G.S., Tenant Farmer, Ongar Park, Essex.—(Crosby, Lockwood and Co. 21s. nett), 1902.*

This valuable work is divided into fourteen chapters. One to iv. are mainly occupied with the origin and formation of soils, their mineralogy and physiography. Chapter v. deals with drainage and water-supply; vi., vii., viii., ix. and x. are concerned with formations and farming, and the evolution of live stock occupies chapters xi., xii., xiii. and xiv

Many who casually turn over the pages of this book and note the vast area from which Mr. McConnell's examples and illustrations are derived, may be inclined to suppose it too deficient in local interest to be noticed in the ESSEX NATURALIST. But a glance at the preface will reveal the fact that the author for the last twenty years has been farming on the London Clay in Essex, and that he dates from "Ongar Park Hall," Ongar. It is therefore obvious, that no persons are so likely to find his researches specially interesting as residents in that county. And in the remarks to follow it seems best to keep in the main, to matters of local interest, referring those interested in the broader aspects of the subject to Mr. McConnell's book.

Our author (p. 31) complains of the apathy of the Government as to the interests of agriculture shown in the case of the Geological Survey and its neglect for so many years of the superficial deposits. But the public opinion of the country sixty or seventy years ago was felt to be very unlikely to consent to grants of money for scientific purposes unless they could be justified by the strongest economical reasons, Accordingly the most weighty argument put forward for the establishment of a Geological Survey, and, in its earlier years, for its continuance, was the statement that a knowledge of the geological structure of the country would at once check the making of useless borings and sinkings and show where they might be made with success. In this way immense sums of money would be saved to the country, while the cost of the Survey would be comparatively trifling. Hence the Survey work began in the mining districts of the north and west, and was carried on with the utmost possible speed, so that its use purely as a business matter, might be obvious to the most unscientific of politicians. This necessarily involved the

neglect of superficial beds of every kind. For, on a coal field, for example, the outcrops of the rocks of Carboniferous age, with the lines of fault crossing them, are the fundamentally important things to be noted on the geological map. To show, in addition, the superficial beds, would often be but to obscure the most valuable information, as well as to retard the progress of the Survey. And similar reasoning would apply more or less to formations directly underlying or overlying the Carboniferous series. The special needs of the miner may be shown by the following illustration. In pre-geological days there was a popular view in the Northumberland and Durham, and in the Yorkshire and Derbyshire coalfields that there was "no coal under the limestone." This was true of the Carboniferous Limestone on the west, but utterly untrue of the Magnesian Limestone eastward. Other examples might be given, but the supreme importance, in mining, of a knowledge of the geological structure of a district hardly needs further illustration.

On the other hand, a knowledge of the geological structure of a country has not the same importance to the farmer. Let us, for example, again take two limestones, each of which occupies a considerable proportion of the surface of England, the Carboniferous Limestone and the Chalk. We learn from Mr. McConnell that the grass growing on the bare Carboniferous (or Mountain) Limestone is exceptionally sweet and nutritious, fattening sheep in a few months. The grass growing on the bare Chalk is also excellent for sheep, as we all know from the reputation of the South Down breed. But it would be obvious to any farmer that in each case the sheep fed on grass growing on bare limestone, and he would need no knowledge of the geological structure of the respective districts or the comparative ages of the limestones.

But though, regarding England as a whole, the claims of the miners for geological information are manifestly greater and more fundamental than those of the agriculturists, the counties of Norfolk, Suffolk and Essex have unquestionably been under a special disadvantage in the postponement of drift maps till the claims of the miners were satisfied. This becomes obvious when drift maps and non-drift maps are compared with each other. A drift map of Kent, when compared with a non-drift map, seems but to possess some additional details. Drift maps of Norfolk, Suffolk and Essex, compared with non-drift maps of those counties, look like maps of districts of utterly different geological composition.

As regards the formations of Essex and their farming qualities, nothing is said by Mr. McConnell of Chalk in connection with that county, though its capabilities as seen elsewhere are noted. Chalk, however, occupies but a very small proportion of the surface of Essex, being found only in the north-west corner and between Purfleet and East Tilbury. And the lowest Tertiary beds, the Thanet Sand and the Woolwich Series, occupy but very narrow strips of country adjacent to those where the Chalk is seen. The next, in ascending order, the Oldhaven Beds, cover but an insignificant area in Essex; but we learn that at Hassenbrook Farm, near Stanford-le-Hope, a small, thin patch of this formation occurs, largely composed of rolled flint pebbles in sand; and that it is the best strawberry land in the district. The London Clay, which comes next, forms a very large proportion of the surface in southern and eastern Essex. As regards its character as a soil, it is described as being

specially suitable for grass, and as once (when wheat was dear) having been valuable for growing wheat, clover and beans. Mr. McConnell, however, thus gives his own experience of it :—

"The greater part of the author's farm is situated on this clay, so that he has learned from sorrowful experience what the nature of the soil is. Tiptree Hall—farmed by the late Mr. Mechi—is also on this soil and is now a fruit farm."

We are also informed that "the general contour of the land is a low, uneven, gentle undulating surface, the highest land not much over 400 ft. over sea level, though some few hills in Essex reach 600 ft."

The present writer has never been able, aided by the new ordnance maps, to detect any hills in Essex having a height of 500 ft. The highest ground appears to be on the Chalk of the north-west corner.

Of the Lower Bagshot sands and gravels we learn that, though sometimes too sandy or gravelly for fertility, yet while they have not the "body" of the London Clay, they are more easily and satisfactorily worked. They cover but a small area in Essex compared with the London Clay, on which they lie as isolated patches at Brentwood, Rayleigh, Laindon Hills and elsewhere.

The Pliocene "Crag" of Eastern Essex is still more insignificant as a maker of soil. It is the highest bed shown on a non-drift map except the alluvium of the river marshes.

By far the most important of the drift beds is the Chalky Boulder Clay, which probably occupies at least as much of the surface of Essex as all the other beds combined, and a still larger proportion of that of Suffolk. Mr. McConnell states that it covers about 3,000 square miles in the Eastern Counties. He has about 50 acres of it on his own farm, capping the undulations of the London Clay, and finds that "it is the only arable land he has that is fit for cultivation, the rest being London Clay." The Chalky Boulder Clay appears to make good wheat land. He adds that "in the course of ages a large part of the lime has been dissolved out of the surface layer." This point makes the detection of Boulder Clay so doubtful when only shallow sections are exposed. But it is satisfactory to learn that "there is still sufficient left to supply the soil for plant needs; while the existence of marl pits shows that much of this marly clay was dug and spread on the surface in the olden times; in fact, if the subsoil is dug into almost anywhere, beds and streaks of bluish-white marl are found in abundance."

It is interesting to learn that the sand and gravel of the Glacial Period, which underlies the Chalky Boulder Clay, has generally a large admixture of earthy matter in it, and forms a good loamy soil which compares favourably with that of either the London Clay or the Boulder Clay, both in the neighbourhood of Ongar and that of Chelmsford.

On the other hand, the patches of gravel coloured red on the drift maps, which appear at High Beach, Laindon Hill, Rayleigh, and elsewhere in southern Essex, and are considered to be of pre-Glacial age, are barren gravels, "given over to gravel-pits and the growth of birch or copsewood." Similarly barren are the Post-Glacial gravel patches, coloured orange.

As regards old river deposits, our author speaks highly of the loam or brickearth in the neighbourhood of Southend and Rochford.

In the chapters on "The Evolution of Live-stock" some curious facts about sheep are mentioned. At a place in Derbyshire a "fault" separated a limestone area from one in which silicious grit formed the surface, The sheep were all of one breed. But while those which fed on the lime-stone were healthier and made better mutton, those which fed on the sandstone had superior wool. Bakewell, it appears, classed wool soils thus:—Clay, the best; sand next; lastly lime. But we are also reminded of "the effect of clay formations—as the Oxford Clay—in developing such diseases as liver-fluke and foot-rot."

It seems to me, however, worth suggesting that possibly much of the ill-health of sheep on clay may be due to bad water supply.

But it is impossible, in the space available in the ESSEX NATURALIST, to discuss adequately a book which covers so large a field as this, and is the result of so many years' hard work, both in the library and on the farm. It is a pleasure to be able to congratulate the author on the success of his labours, and to recommend his book to all who are interested in Agricultural Geology.

T. V. H.

The Giant Beaver (*Trogontherium*) in the Thames Valley.—In the *Geological Magazine* for September (1902) there is a short paper by Mr. E. T. Newton, F.R.S., F.G.S., on "The Giant Beaver (*Trogontherium*) from the Thames Valley." Mr. Newton remarks that English specimens of *Trogontherium* have been chiefly obtained from the 'Cromer Forest Bed,' "that rich and remarkable series of beds occupying a position in time, between the Crags and the Glacial deposits of East Anglia." A few specimens have, however, been found in the Norwich and Weybourn Crags. Now a lower incisor tooth of *Trogontherium cuvieri* has been met with in a bed of gravel (at 78 feet O.D.) an old Thames Valley deposit, near Greenhithe, Kent, together with remains of *Elephas antiquus. E, primigenius, Rhinoceros, leptorhinus, Bos primigenius*, etc., and many Palæolithic implements. The implements have been figured and described by Mr W. M. Newton in *Man* for June, 1901.—T. V. H.

The Matrix of the Suffolk Chalky Boulder-clay.—A paper on this subject, by the Rev. Edwin Hill, M.A., F.G.S., appears in the *Quarterly Journal, Geological Soc.* (vol. lxviii., pp. 179-182. It need hardly be remarked that the Suffolk Boulder Clay is also that of Norfolk and Essex, though it covers a larger proportion of Suffolk than of the counties due north and south. Indeed, some of the specimens examined were from the neighbourhood of Bishop Stortford, and one from Finchley in Middlesex, others came from Boston, Lincolnshire, though most were from Suffolk. Mr. Hill remarks that the materials of the matrix do not appear to have come from the east, but from the west or north-west, and that they were drawn from a limited belt lying on one side of the basin which the Boulder Clay occupies.—T. V. H.

ANNUAL REPORT OF THE COUNCIL FOR THE YEAR ENDED DECEMBER 31st, 1901.

[*Read and adopted at the 22nd Annual Meeting on March 22nd*, 1902.]

But a few paragraphs will suffice for a record of the Club's year. The work, both in connection with the Society itself and the Museums, has been mainly of a routine nature, although the Council venture to submit that the scientific credit of the Club has suffered no diminution.

FINANCIAL.—The following is Mr. Howard's report:—"The financial position of the Club is on the whole sound, and, as will be seen from the Statement of Account, the adverse balance is diminished to £5 5s. 6d., but this result has only been obtained by the most strenuous economy. There is an urgent need for an increased roll of members to provide the funds so desirable for the Club's work.

There is also still a great need of funds to enable the Curator to bring the museums up to the right standard of completeness. The case of the Forest Museum is specially urgent, and at the Essex Museum there are no funds available to purchase the specimens required to complete the collections and do other most important work."

MEMBERSHIP ROLL.—The Club has, unfortunately, lost several members by death and removal from the County, and this has tended to reduce the roll, in spite of election of many new Members. As far as can be estimated at present, there are 264 Ordinary Members, Exempt Members 4 and Honorary Members 16, making a total of 284, four less than at the date of the last Annual Report.

MEETINGS.—Eleven meetings were held within the year, the November meeting having been transferred to 1902 in consequence of the usual date being that of an important scientific fixture in London. In addition to the papers read we have had the benefit of several important lectures and addresses by scientific men, and the Council wish to record the cordial thanks of the Club to the following gentlemen:—to Prof. G. B. Howes, F.R.S., who gave an address at the meeting on Feb. 23rd on "Recent Work on Molluscan Morphology"; to Mr. E. Sanger Shepherd who on March 30th gave a most interesting and well-illustrated lecture on his process for producing photographs in natural colours, to Mr. E. M. Holmes, F.L.S., to Prof. J. B. Farmer, F.R.S., and Prof. H. Marshall Ward for assistance at the meeting for inspection of the Forest on May 18th. On this occasion we had anticipated the benefit of the two verderers, Sir T. Fowell Buxton and Mr. E. N. Buxton, but the alarming accident to the former just before the meeting prevented this. It was with great relief that all present heard that no serious consequences ensued.

We have again to thank the Countess of Warwick for kind hospitality at Bigods on the occasion of the visit of the Club on June 6th, and also Mr. and Mrs. Henessy for their courtesy at this meeting. At the meeting on Canvey Island on June 15th we had the great benefit of the leaderships of Dr. Murie and Prof. Boulger On June 29th the Club was the recipient of much kindness and hospitality at the hands of Mr. and Mrs. Sharrock at the Reservoir

works at Tottenham and Walthamstow—the arrangements made by Mr. Sharrock for the comfort of the Members were most thorough and welcome. At the Annual Cryptogamic Meeting on October 12th we again secured the ever welcome assistance of Dr. M. C. Cooke and Mr. G. Massee and Prof. Marshall Ward gave an inspiring address on the "Scientific Study of Fungi." At the Ordinary Meeting in October, Prof. Meldola gave a lecture on "Mimetic Insects," which was admirably illustrated by a very fine series of lantern slides, many of them produced by the Sanger-Shepherd process of photography in colour, the specimens from which they were taken having been arranged by Prof. E. B. Poulton, of the Hope Museum, Oxford.

The papers read at the meetings have been, or will be, published in our journal.

Although a matter hardly officially connected with our Field Meetings, the Council cannot refrain from recording the very kind invitation for the meeting at Bigods on July 24th given to the members of the Club by the Countess of Warwick, which was highly appreciated by those who accepted the invitation.

The Council also wish again to record their high appreciation of the valuable facilities for holding meetings in the Institute granted by the Technical Instruction Committee of the Borough of West Ham. And the kindness of the Principal, Mr. Briscoe, has been most marked during the year, enabling our meetings to be carried with a facility and success not to be equalled in the history of the Club.

ESSEX NATURALIST.—Three parts of the journal were published during the year, comprising 234 pages, with six full-page plates and numerous other illustrations. The Council has to thank Mr. F. W. Reader for several valuable blocks, for much care taken in copying drawings for re-production and generally in assisting the editor in preparing matter for the press; also Mr. H. A. Cole for drawing of the Dug-out Boat discovered in the Alluvium of the Lea Valley.

The somewhat irregular appearance of the ESSEX NATURALIST is still a source of great regret to the editor, but he hopes to remedy this soon, as the pressure of other work in connection with the two museums is lessened. But the *amount* of matter issued is evidently almost the maximum which the present financial resources of the Club will permit. There appears to be no falling off in the number of papers of real scientific and local interest sent in, and if it were in our power to print them many others would doubtless be submitted. The editor would also like to have a few illustrations in colour occasionally and to make the records of local scientific events occurring within our districts more systematic and complete. But this is impossible, from the cause hinted at above. We can only have faith and await the "Good time coming." At present the hope seems bound up with an increase of membership. One hundred more members would enable us to nearly double the present issue of the NATURALIST and to mould it more into the form of a quarterly journal of Natural History in a wide sense of these words.

ESSEX MUSEUM OF NATURAL HISTORY.—The history of affairs at the Museum was brought up to the end of 1900 in the last report, and a full account of the opening of the Museum to the public on October 18th, 1901,

ESSEX FIELD CLUB.

Treasurer's Statement of Receipts and Expenditure for the Year 1901.

GENERAL RECEIPT AND EXPENDITURE ACCOUNT.

Receipts.	£	s.	d.
To Subscriptions, arrears	13	16	0
,, ,, 1901	137	4	0
,, ,, 1902	2	0	6
,, Life-Compounders for *Essex Naturalist*		9	0
,, Balance of Library Account	1	15	0
,, ,, from Life Composition	1	3	10
,, Deficit	5	5	6
	£161	13	10

Expenditure.	s.	d.	£	s.	d.
By Balance (Deficiency from 1900)	7	0			
Less in Secretaries' hands	5	8			
				1	4
,, Printing and Illustrating *Essex Naturalis*			47	17	4
,, Printing (Circulars, &c.) and Stationery			14	7	6
,, Postage of *Essex Naturalist*, Circulars, Correspondence, etc.			17	8	6
,, General and Incidental Expenses			8	1	6
,, Library Expenses			4	13	5
,, Lecturers' Fees			4	4	0
,, Amount transferred to Essex Museum (West Ham) Maintenance Fund			50	0	0
,, To Life Composition Account			10	0	0
,, Loss on Field Meetings, as *per* Hon. Secretary's Statement			5	0	3
			£161	13	10

ESSEX MUSEUM (WEST HAM) MAINTENANCE FUND.

Receipts.	£	s.	d.	£	s.	d.
To Balance at Bank	68	4	1			
,, ,, in Secretary's hands	6	14	10			
				74	18	11
,, West Ham Corporation				100	0	0
,, Transferred from General Account				50	0	0
,, Sale of Handbooks				2	3	1
				£227	2	0
Due to Curator—£45 17s. 6d.						

Expenditure.	£	s.	d.	£	s.	d.
By Curator's Stipend and Railway Fares				111	15	0
,, Printing Handbooks				11	17	0
,, Removal of Specimens				1	0	0
,, Fire Insurance				1	15	0
,, Sundries				8	1	4
,, Curator's Disbursements				10	6	3
,, Balance at Bank	74	17	7			
,, ,, in Curator's hands	7	8	10			
				82	6	
				£227	2	0
Due to Curator—£40						

ESSEX MUSEUM (WEST HAM) EQUIPMENT FUND.

Receipts.	£	s.	d.
To Balance at Bank	65	4	9
,, Deficiency		13	6
	£65	18	3

Expenditure.	£	s.	d.
By Printing	3	1	6
,, Cases	17	0	0
,, Specimens, etc.	45	16	9
	£65	18	3

EPPING FOREST MUSEUM CAPITAL AND MAINTENANCE FUND.

Receipts.	£ s. d.	Expenditure.	£ s. d.	£ s. d.
To Balance ...	5 9 1	By Printing...		3 18 0
,, Subscriptions	6 10 0	,, Fittings for Museum		69 15 0
,, Donations	102 2 6	,, for Secretary		3 3 10
		,, Balance at Bank	35 8 7	
		,, ,, in hands of Secretary	1 16 2	
				37 4 9
	£114 1 7			£114 1 7

SPECIAL MEMOIRS AND PUBLICATIONS ACCOUNT.

Receipts.	£ s. d.	Expenditure.	£ s. d.
To Sale of Publications	2 17 5	By Balance (Deficiency from 1900)	15 6 8
Balance (Deficiency)	12 9 3		
	£15 6 8		£15 6 8

SUMMARY OF BALANCES, JANUARY 1st, 1902.

	£ s. d.		£ s. d.
To Epping Forest Museum	37 4 9	By Cash at Bank	132 1 7
,, Essex Museum Maintenance	82 6 5	,, ,, in Treasurer's hands	3 10 6
,, Life Composition	115 0 6	,, ,, in Secretaries' hands	3 8 1
		,, Investments	89 12 6
		,, Deficit Museum equipment	13 6
		,, General Fund	5 5 9
	£234 11 8		£234 11 8

Having examined the above Accounts with the books, vouchers, and Banker's pass-book, we find the same correct.

18th March, 1902.

WALTER CROUCH,
JOHN D. COOPER, } *Hon. Auditors.*

has since been printed in the ESSEX NATURALIST. The work during the year 1900 was necessarily mainly confined to improving the arrangement and increasing or renewing the specimens in several departments.

The removal of the three centre cases from Chingford to the main Museum has enabled the curator to improve the collection of mammals and at the same time allow of more space being given to the birds. The Corporation Committee largely aided in the reconstruction of these cases, and they also kindly gave orders for the making in the workshops of the Institute of 13 square wall-cases for the reception of some of the smaller animals and for botanical collections. Ten of these cases are at present temporarly filled with selections from the Essex collection of Seaweeds. The authorities of the Institute also allowed the curator to place four large cases containing the general collection of fossils in the gallery. Mr. H. E. Smedley, F.L.S., lent his series of wax models of British Fungi, made by himself, and the collection was for some time a very beautiful and attractive exhibit in the gallery. On the removal of Mr. Smedley's collection our member, Mr. J. Avery, kindly lent a large selection from his collection of engraved views of Essex, and this has been arranged round the gallery, the Institute constructing the frames to contain the pictures.

The principal additions to the Museum during the year were the acquisition by purchase of the Cryptogamic collection of the late Mr. E. G. Varenne, of Kelvedon; a considerable number of specimens of plants from our late member, Mr. Sewell; a large number of Lepidoptera from our late member, Mr. F. Coles; archæological specimens from Mr. F. W. Reader and his brother, Mr. T. W. Reader; Palæolithic implements from Somaliland from Mr. Seton-Karr, together with other specimens of stone implements; and of a beautifully set-up specimen of the Kite, formerly belonging to the late Mr. Henry Doubleday, by Mr. J. E. Harting.

The arrangement of the specimens in hand will necessarily take a long time. The curator has had the benefit of the assistance of Mr. H. Whitehead who had been appointed by the Technical Instruction Committee, but Mr. Whitehead's time being largely occupied in other ways, the progress has been slow. The work of the curator is also hampered by want of space, and still more seriously by want of sufficient funds to obtain the necessary cabinets, cases and appliances, and the special specimens and preparations urgently required. Meanwhile he can only once more appeal to the members of the Club, and to those interested in the museum "idea" for assistance both financial and scientific. There are thousands of species still required, and we are in need of systematic collecting in most groups. Essex is a very rich county, but specimens must be gathered with skill and care to be available for museum purposes.

EPPING FOREST MUSEUM.—As reported at the last Annual Meeting, the re-arrangement of the collections, and additions thereto, has now been taken in hand. A Committee has been appointed, under the chairmanship of the Rev. A. F. Russell, and a public subscription started to obtain the funds necessary to carry out the scheme proposed by the curator. A considerable sum has been subscribed, but more money is still needed. The work of reconstruction has been carried on slowly through the year, and the major

portion of the cases are now nearly ready. The curator had hoped to complete the work by May or June next, but this is hardly possible now, unless the Museum Fund is considerably increased. The museum is vastly improved by the additional space and new fittings, and the Council venture to think that when completed it will be a most useful and popular addition to the attraction of the Forest, and a valuable supplement to our main museum. A full report will be submitted by the Museum Committee when the work is more nearly completed.

The only considerable addition is the series of specimens from the Lea Valley Excavations at the new Reservoir Works at Tottenham and Walthamstow. The Council has to thank in this connection Col. Bryan, Mr. Sharrock, Mr. Marsh and Mr. Traill, for their kindness and assistance afforded during the visits to the works, and the care with which the various relics were preserved and forwarded to the Museum.

The Council have also to thank Mr. Chalkley Gould for his continued assistance in arranging the series of specimens from the Romano-British Settlement at Chigwell.

CONFERENCE OF "EAST ANGLICAN" NATURAL HISTORY SOCIETIES.—The Second Conference was by invitation of the Club held at Dunmow on June 6th, but only two representatives of the Norfolk and Norwich Society attended and none from Ipswich. Members of the Essex Field Club attended in numbers. A very pleasant conversation took place, introduced by Mr. W. Cole in some remarks on the advisability of initiating a scheme for systematic collecting, more especially of marine forms. But under the circumstances no action could be taken. It is now suggested that the Third Conference should be held during the ensuing summer at Ipswich, and that town being central for the "East Anglian" district it is hoped that a goodly company will attend the meeting, and some practical work may be begun.

In connection with conferences the Council have to thank Mr. F. W. Rudler, F.G.S., for acting as the Club's representative at the British Association Meeting at Glasgow. Mr. Rudler, as Chairman of the Conference, put forward some valuable advice, which will be found summarised in the report which he has sent in for publication in our journal.

PRESIDENCY.—The Council has great pleasure in recommending the re-election of Prof. Meldola as President of the Club for the ensuing Club year.

HONORARY MEMBERS.—The Club has recently lost by death three very eminent Hon. Members. In view of this and with the desire of strengthening the scientific position of the Club, the Council recommend that the following gentlemen be elected at the Annual Meeting as Honorary Members of the Club. All these gentlemen have expressed themselves very favourable to the work the Club is trying to do, and several of them have already done yeoman's service in our interests :—

List of Eminent Scientific Men suggested for election at the Annual Meeting, 1902, as Honorary Members of the Club.

W. H. Dalton, Esq., F.G.S. (*late of the Geological Survey,*)

Prof. J. B. Farmer, M.A., F.R.S., *Professor of Botany, Royal Coll. of Science.*

Prof. G. B. Howes, LL.D., F.R.S., F.L.S., *Professor of Zoology, Royal College of Science.*

Prof. E. Ray Lankester, M.A., LL.D., F.R.S., F.L.S., &c., *Director of the British Museum of Natural History.*

C. H. Read, Esq., F.S.A., *Keeper of the British and Mediæval Antiquities British Museum.*

Sir W. T. Thiselton-Dyer, K.C.M.G., LL.D., F.R.S., F.L.S., &c., *Director of the Royal Gardens, Kew.*

Prof. H. Marshall Ward, D.Sc., F.R.S., F.L.S., *Professor of Botany, University of Cambridge.*

H. B. Woodward, Esq., F.R.S., F.G.S., *Geological Museum, Jermyn Street.*

[N.B.—All the above gentlemen were elected at the Annual Meeting on March 22nd, 1902.]

THE ESSEX FIELD CLUB.

THE 208th ORDINARY MEETING.

SATURDAY, JANUARY 25TH, 1902.

The 208th Ordinary Meeting was held at half-past six o'clock in the Physical Lecture Theatre of the Municipal Technical Institute, Stratford, the President, Prof. R. Meldola, F.R.S., in the chair.

Mr. Frank Woolnough, *Curator of the Museum, Ipswich*, was elected a member of the Club.

At the commencement of the proceedings, Mr. Cole said that the members would lament the death of Lord Rookwood, one of the Life Members of the Club, and a gentleman who had earned the esteem and gratitude of all interested in the county of Essex. Before he became a peer, as Sir Henry Selwin-Ibbetson he was largely concerned in the rescue of Epping Forest, and he piloted the Epping Forest Act through Parliament. Later, he aided the Club in defeating encroachments on the Forest by railway and tramway companies. In many movements made for the benefit of the county, Lord Rookwood took a leading part, and his loss would be long regretted. He died in London January 15th, 1902 in the 77th year of his age. Mr. Cole concluded by moving that he should be empowered to send a letter of condolence in the name of the Club to Lady Rookwood on the death of her distinguished husband.

This was seconded by the President, who cordially supported the tribute of esteem put forward, and the resolution was carried unanimously.

Mr. T. V. Holmes, F.G.S. exhibited a drawing of an old wooden water-pipe, found in making excavations in Wigmore Street, London, and made some remarks on these disused methods of conveying water. He thought that ancient contrivances of the kind were worth recording, inasmuch as they were so soon wholly forgotten.

Mr. Holmes afterwards embodied his observations on ancient wooden water-pipes in a paper which will be printed in the ESSEX NATURALIST.

Mr. J. Chalkley Gould exhibited some pottery and coins from the Romano-British Settlement at Chigwell, Essex, which he had obtained in continuation of the series of relics from that spot already exhibited in the Epping Forest Museum. Mr. Gould made some remarks on these specimens which are given in the "Museum Note" in the present part (*ante* pp. 238-40.)

The President said that they were all much indebted to Mr. Gould for the persistence and success with which he was watching the excavations at Chigwell. He also expressed his satisfaction at finding Mr. Gould inclined to deposit all the specimens in the Club's Museum at Chingford. It so commonly happened that relics of the kind got dispersed in private hands, and the evidence which they might afford was practically lost. All such objects should be carefully preserved, registered, and brought, as it were, to a focus in some local Museum.

The President exhibited and presented two or three fashioned flakes from Sherringham, Norfolk. He had found and kept these, not for any intrinsic value, but he was unaware whether worked flints had hitherto been found at Sherringham, and therefore it would be well to preserve these.

The Secretary said that Mr. Seton-Karr had recently sent to him a set of Stone Implements of Palæolithic type, found by himself in Somaliland, Eastern Africa, with a request that the Club should select six specimens for the Museum and distribute the remainder among various English and Continental Museums named by Mr. Karr. The Secretary exhibited the whole set of 38 implements. Mr. Seton-Karr had described his specimens in *Journ. Anth. Inst.*, vol. xxv. (1896) p. 172, pl. xix.-xxi. *Brit. Assoc. Rep.*, 1895, p. 824. And Sir John Evans had more recently (*Proc. Royal Society*, vol. lx. (1896) p. 19) called attention to this subject (see also Evans' *Ancient Stone Implements*, 2nd Ed. (1897) p. 653.) Sir John remarked on the identity of form of the implements with those found in the Pleistocene deposits of North-western Europe and elsewhere.

Mr. Cole also exhibited a collection of various stone implements previously presented to the Museum by Mr. Seton-Karr.

Mr. F. W. Reader made some extended remarks on these specimens which will be embodied in a "Museum Note" in a future part of the E. N., and moved that a vote of thanks be sent to Mr. Seton-Karr for those welcome contributions, which had so greatly enriched the Club's collections.

Mr. Charles H. Read, F.S.A., remarked that these implements certainly very closely resembled the Palæolithic types found in Britain and on the Continent, but he urged caution in assuming that they were actually of Palæolithic age. So far as he knew, there was absolutely no *geological* evidence at present forthcoming upon which to base accurate conclusions as to the age of these implements.

The vote of thanks to Mr. Seton-Karr was carried unanimously.

Mr. George Massee, F.L.S., communicated a note on the occurrence in Epping Forest of *Amanita citrina*, a species new to Britain. And he also sent for the Museum an original coloured drawing of the species (Mr. Massee's note appeared in the last part, *ante* p. 129.)

Mr. W. Cole said that the remarkable point about Mr. Massee's discovery was, that this conspicuous fungus should have escaped the notice of all the acute botanists who had for 21 years attended the Annual Fungus Forays of the Club. It was possible that the recent extensive thinnings in the Forest had somewhat altered the character of the soil, and that the resulting conditions had proved more favourable for the *Amanita* than those previously obtaining.

The President, in proposing a vote of thanks to Mr. Massee, alluded to the hypothesis of the deferred germination of the buried seeds of plants, as being possibly analogous to the case of the Hymenomycete.

The vote of thanks was carried unanimously.

Mr. Charles H. Read, F.S.A. (Keeper of the Department of British and Mediæval Antiquities, British Museum) then gave a most interesting and instructive Address on the subject of Local Archæological Investigation He urged the importance of such a society as the Essex Field Club making a careful examination of the numerous prehistoric sites in the county. But in conducting such explorations great caution was necessary. An earthwork should be explored only by persons acquainted with the right methods of working and the varied knowledge of the geologist, antiquary and ethnologist was often necessary to conduct the enquiry on right lines and to correctly interpret the results obtained. He advised the making of an archæological survey of the county, plotted down on a large scale map, as being one piece of work well within the power of a local society. On it all barrows, mounds and other indications of prehistoric occupation should be carefully marked down. Then should these sites be threatened by the interference of the owners of land or other persons, the opportunity should be taken by the Club, to make explorations carefully and scientifically, so as to prevent the misfortune which they had so often to lament of the destruction of prehistoric monuments with no record of evidence from which their nature or period could be inferred.

The lecturer alluded to the very interesting "Red Hills" of the Essex Estuary lands, from which the series of specimens in the Museum had been obtained by Mr. Cole. He thought that these remains should be investigated, and suggested that the Society of Antiquaries might possibly make a grant to the Club towards the expenses of exploration.

Mr. Read referred to the great want of exact knowledge of the sequence of the "Bronze Age" and the importance of gathering all the evidence possible before it was too late to do so. Although he recognised the great value of local Museums, he deprecated the establishment of a large number, because he feared the interest in them would thereby be lessened by the diffusion of objects which were best studied and appreciated when gathered together in large collections. He also pointed out that it was not conducive to the promotion of archæological knowledge to keep in local Museums objects of extreme rarity which had no relation whatever to other exhibits. It was much better to send these to the National Museums, where perhaps such an object would find a place among the larger series of antiquties, and even fill a gap in a world-wide collection.

The President, in proposing that the thanks of the Club should be given to Mr. Read for his valuable and suggestive address, pointed out that historical records, of the nature of local traditions, very often clung with great persistence

to ancient remains and, however erroneous, were never dispelled till the shovel and pick had been brought to bear upon them. He referred to the Club's explorations of the Epping Forest earthworks as examples of exploration by scientific method which had been instigated by the late Genl. Pitt Rivers. Prof. Meldola further expressed satisfaction that the Society of Antiquaries was carrying on the work of the Archæological Survey, although he feared that Essex had not much to show so far in this direction. With reference to the occurrence of palæolithic remains in their county he reminded the meeting that they had been fortunate at the outset of their career in having had among them such a keen observer as their hon. member Mr. Worthington Smith, some of whose earliest contributions to the subject had been published by the Essex Field Club. The President also expressed his great interest in Mr. Read's suggestions with reference to the registration and preservation of the prehistoric remains of the county and he referred to the similar proposals brought by him in 1883 before the Club and the Conference of Delegates of Corresponding Societies at the Southport meeting of the British Association (see *Trans. Essex Field Club*, vol. iv., p. 116). Coming as these suggestions now did from an archæologist of such distinction as Mr. Read, he hoped they would bear practical fruit and that the Club would continue the work of scientific exploration of the ancient remains of the county which they had already commenced under such favourable auspices. There yet remained an immense amount of work to be done in this field, and he expressed the hope that the systematic investigation of the mysterious "Red Hills" to which Mr. Read had alluded would be taken in hand before long.

Mr. T. V. Holmes thought that they might well be congratulated on Mr. Read's valuable address. In illustration of the damage done in former years to ancient earthworks by persons ignorant of the interest attached to them he might mention that Mr. W. Cole and he visited Pictsbury Ramparts, near Colchester, a few days after the occurrence of the Essex Earthquake. The camp appeared on the map of the Geological Survey (48, S.W.) as a complete oval. But they found about three quarters completely removed, and only about one fourth (which was within the boundaries of a wood) preserved. The destruction had been done simply as an agricultural improvement, though on meeting the farmer occupying the land, and talking with him about it, they learned that the removal had been a costly piece of work, and scarcely a profitable one. It was described as a pretty spot, the ramparts having once stood about 30 feet high, where, at the time of our visit there was a perfect level. In Greenwich Park, there still remained many low tumuli on the top of the hill between the Observatory buildings and the gate at the top of Crooms Hill. In the year 1844, we learn from *Hasted's History of Kent* (Part I. *Hundred of Blackheath with additions by Streatfield and Larking*, edited by H. H. Drake, London, 1886), that the reservoir a few yards south of these barrows was made. Many barrows were destroyed to obtain material for the banks bounding the reservoir before orders were given to stop the destruction, and oblige the constructors of the reservoir to obtain their gravel a few yards farther away. We also learn that these barrows were opened in the year 1784 by permission of the Surveyor of the Royal Domains and some glass beads, braids of human hair, and patches of woollen cloth found in them, But it also appears that about 70 years before the date of this exploration.

" one Hearne, a park-keeper, had opened these barrows, and no doubt removed many valuable relics." The appearance of some of the more prominent barrows still remaining shows that " exploration " implied simply digging into them from the top.

Mr. J. Chalkley Gould said however much we may deplore the destruction of Pictsbury Ramparts, to which Mr. T. V. Holmes has just referred, we must remember that vandalism was perpetrated by some (probably needy) farmer anxious to make the utmost of his land, but what shall be said of the British Government which a few years ago destroyed the greater part of the interesting earthwork at Shoeburyness—a work which is of so great interest not because of its size, but for its definite mention in the Saxon Chronicle? We hope that the present War Office authorities are careful of the fragment which remains.

With regard to the settlement of the Saxons in our county, which appears to have been accomplished so much later than similar settlements elsewhere, Kent and Suffolk for instance, it would be work worthy of the Essex Field Club by investigation of any sort to throw light on this subject and the reason for the later occupation.

Mr. Read's address was so full of matter that one could talk long of the points it suggests, but he would only refer to the remarks upon the multiplication of museums. There is no doubt that their undue increase would weaken the character of all and to establish too many will be a serious mistake.

Mr. A. S. Kennard pointed out the difficulties under which the archæological student laboured, arising from the indifference of the general public. He noted that two most important discoveries in connection with the " Bronze Age " had been made in Essex, one being the largest bronze sword yet found in this country, and the other a magnificent hoard of bronze spear heads of an extremely raw type. He urged the importance of describing all objects of interest as soon as it was possible. He pointed out how utterly untrustworthy with the statements often made by the labourers and warned the members against a well-known forger of flint implements at present living in Essex.

The discussion was continued by Mr. Reader, Mr. Briscoe, who advocated the establishment of a photographic survey of Essex by the Club in connection with the Museum, and by Mr. W. Cole and others.

A very cordial vote of thanks was passed to Mr. Read, who replied on some points alluded to by the speakers.

Mr. W. H. Dalton, F.G.S., exhibited and presented to the Museum some specimens of brackish water Mollusca from Fowlness, Essex, which had been collected during the past summer by Mr. Llewellyn Owen.

THE 209th ORDINARY MEETING.

SATURDAY, FEBRUARY 22ND, 1902.

The 209th Ordinary Meeting was held in the Technical Institute, Stratford, at 6.30 p.m., the President, Prof. R. Meldola, F.R.S. in the chair.

Mr. F. W. Green was elected a member.

The Secretary read a letter from Lady Rookwood, thanking the Club for the vote and letter of condolence upon the death of her husband, Lord Rookwood, passed at the last meeting.

The first business was the announcement of retirements from the Council, and the nomination of new members of Council and Officers for election at the Annual Meeting on March 22nd.

The nominations were duly made, and the list of Councillors and Officers is given in the report of the Annual Meeting, *post* p. 260.

The Secretary announced that the Council were desirous of recommending that the Club should elect several eminent scientific men as Honorary Members at the Annual Meeting. But it had been found that to do this alterations would be necessary in Rule II, and Rule XII.

Mr. Cole therefore gave notice that at the next meeting he would move such necessary alterations (see *post*, Meeting on March 8th).

Mr. F. W. Elliott exhibited a portion of a quern, which had been found in a garden at Buckhurst Hill, but there was no direct evidence of its true place of origin.

Mr. Chalkley Gould said that the quern was of the kind frequently found in Essex.

The Secretary exhibited two books recently presented to the Club, viz. the new edition of the *Handbook of British Birds* by the author, Mr. J. E. Harting, F.L.S. and Connold's *British Vegetable Galls* presented by Miss Read. He also said that he had arranged for the exchange of publications and information with the Fisheries Board for Scotland and the Northumberland Fisheries Station.

He also exhibited four beautiful specimens of the Bearded Tit or "Reed Pheasant" as it was called in Essex, where it was once common in the marshes below Barking Creek, (*Panurus biarmicus*). These specimens were from Rickling Fen, Norfolk, and were presented by Mr. J. E. Harting. And he announced that Mr. Harting had given to the Club his collection of Land and Fresh-water Shells, the collection being that used in the preparation of Mr. Harting's little book, *Rambles in search of Shells;* most of the beautiful original drawing for the illustrations in that work were made from the specimens in the collection.

A vote of thanks was passed to Mr. Harting for his interesting gift, the President remarking that this was only one of Mr. Harting's many kindnesses to the Museum.

Mr. John Avery read a paper on "George Edwards, the Stratford Naturalist," and exhibited a very fine engraved portrait of Edwards. (Mr. Avery's paper will appear in the ESSEX NATURALIST).

The President said that they were much indebted to Mr. Avery for placing on record another Essex worthy, who must have been a man of very considerable talent to have gained the Copley Medal of the Royal Society.

Mr. Walter Crouch also made some remarks upon the paper.

A lecture was then given by Prof. E. B. Poulton, M.A., F.R.S., Hope Professor of Zoology, University of Oxford, entitled "Protective Resemblance, Warning Colours and Mimicry: Some new illustrations of well-known Principles." The lecture was illustrated by a very extensive and

beautiful series of lantern-slides, many of them being coloured, and some were striking examples of the new three-colour process of photography.

It is impossible to give in a short space, and without illustrative figures, a report which would do justice to Prof. Poulton's admirable exposition of a difficult subject. His remarks and examples extended over almost the whole range of the theories of Mimicry of Bates and Müller among butterflies, Protective Resemblance among caterpillars and other insects, and Agressive and Protective Resemblance amongst crustaceans, reptiles, &c. Many striking instances of "Warning Colours" were shown, and the speaker especially dwelt on the expansion of the theory of common warning colours of Müller brought about by the recent observations of Messrs. Marshall and Shelford. Prof. Poulton also described the remarkable discovery of the American artist, Mr. Thayer, which is illustrated in the models of birds in the British Museum and in the Hope Museum, showing that the light colour of the under sides of many birds and animals serves to practically render them invisible when illuminated from above, as in nature. The lecturer suggested that these models should be reproduced in the Club's Museum.

The President, in proposing a vote of thanks to Prof. Poulton for his admirable lecture, said that they were particularly indebted to that gentleman for having taken the trouble to come up from Oxford for the purpose of addressing the Club, this being the third occasion on which the Hope Professor had given them the pleasure of hearing from him the results of his continued investigations in that field of biology which he had cultivated with such distinction. The lecturer had referred in the course of his remarks to his own (the president's) contributions to this subject, but he thought that the best contribution he had ever made was the discovery of Prof. Poulton himself. Referring to the different subjects dealt with by the lecturer he emphasized the point so well brought out by the magnificent illustrations shown, viz., that it would appear as though natural selection had been at work with an eye to artistic effect, picking out every detail of colour, pattern, structure and attitude that could be made use of in adapting the animals to their environment. It was impossible to say whether a species harmonised with its surroundings unless it were seen under natural conditions, and large and apparently conspicuous animals, such as zebras and giraffes, had been shown to be really well adapted for concealment when among their natural surroundings. He (Prof. Meldola) went on to say that he was glad of the present opportunity of being able to make a public recantation of a view which he had many years ago first broached at a meeting of the Essex Field Club. He referred to the light or white colours of the *undersides* of birds and animals. At the time when this subject was being discussed by the Club (see *Proc. E.F.C.*, vol. I., p. vi., and discussion in *Nature*, vol. 31, p. 505 and 32, p. 172) he had not realised that such an arrangement of colours could possibly have the enormous effect in affording concealment that had now been shown to be the case by the American artist, whose models of ducks in the Natural History Museum at South Kensington and in the Hope Museum at Oxford, of which Prof. Poulton had shown them photographs, were well worth looking at. He thought that their own Museum ought to possess such models, which were not very difficult to make.

In ignorance of the optical effect producible by this arrangement of colour he had in 1880 and since, in common with other naturalists, attempted to explain the white colours of the undersides of birds, &c., as being of purely physical origin. That explanation he now unreservedly withdrew in favour of protection by concealment.

With reference to the work on colour adaptability in individuals, as shown by the illustrations of caterpillars, he thought that the lecturer had been too modest in concealing his own share in this most important work. Although he (the President) had by observation arrived at the conclusion that such adaptability existed and had claimed natural selection as an efficient cause of the phenomenon, it was only the experimental investigations of Prof. Poulton, carried on with such consummate skill and patience, that had placed these deductions on a solid basis of irrefutable facts. As an example of concealment by adventitious means he reminded them that they in Essex had the well-known case of the larva of the Essex Emerald Moth (*Geometra smaragdaria*; see ESSEX NATURALIST, vol. I., p. 120).

The President also expressed concurrence with the strictures which the lecturer had imposed upon the conclusions drawn from the experiments of those who, like Plateau, had actually tasted insects having warning colours and because they could find no unpleasant taste had inferred that the whole theory of distastefulness was erroneous. It was impossible to institute a comparison between the senses of taste and smell of man and of insect-eating birds and animals. Distastefulness might be associated with quite other characters than those of taste or smell as interpreted by our senses. Cantharidin, for example, a product of the blister-beetle, would be an extremely unpleasant thing for a bird or animal to get into its mouth although possessed of no distinctive smell as far as we know. An insect producing this compound as an active defensive principle might derive the full advantage of having warning colours without any nauseous smell or taste at all. The danger would only be realised after the insect had been taken into the mouth by its enemy. Hence the value in such cases of danger signals.

The President went on to say that the development of the Müllerian theory of mimicry in the hands of Prof. Poulton was a source of immense gratification to him since he (the speaker) as the lecturer had told them, had been very largely responsible for the adoption and promulgation of that theory in its initial form in this country. It was the late Charles Darwin who had first sent him in 1879 the publication, *Kosmos*, containing Fritz Müller's modest little paper, accompanied by one of his characteristic post-cards asking him to see if there was anything in it. On looking through the paper he came at once to the conclusion that there was a very great deal in it —how much, they had perhaps been able to realize from the Hope Professor's remarks that evening. Although he was himself a firm believer in the application of Darwinian principles to the cases comprised under the general term "Müllerian Mimicry," he thought it desirable to point out, by way of answer to those who had from the beginning opposed the new ideas with the charge of being too theoretical, that quite apart from the question of the truth of the theory, its utility under the influence of Prof. Poulton had now been demonstrated beyond cavil. Inspired by the new idea the lecturer had set observers and collectors systematically at work in various parts of the

world and some of the results had been submitted to the Club on the present occasion. In the way of results no theory had been more prolific, and the great mass of material accumulated by the zeal of Prof. Poulton and embodied in the collections in the Hope Museum was standing evidence that the departure made in 1879 had been most prolific as a source of substantial facts. He concluded by moving a most cordial vote of thanks to the lecturer.

Some remarks were made by Mr. Elliott and Mr Cole, and the vote of thanks was passed by acclamation.

Prof. Poulton replied on some points mentioned by the speakers.

It was announced that a supplemental meeting would be held on March 18th to clear the slate of some papers in hand, and that at the Annual Meeting on March 22nd the President would deliver an Address dealing with the scientific work of the Club during the 21 years from its foundation.

THE 210th ORDINARY MEETING.

SATURDAY, MARCH 8TH, 1902.

The 210th Ordinary Meeting was held in the Technical Institute, Stratford, at 6.30 o'clock, the President, Prof. R. Meldola, F.R.S., in the chair.

In accordance with notice given at the last meeting, and in the printed circular calling the present meeting, Mr. W. Cole moved :—

> "*In Rule II the word 'twenty' be struck out, and the words 'twenty-five' substituted.*
>
> "*In Rule XII the words limiting the number of Honorary Members to be elected in any one year, to five, to be held in abeyance so far as regards the present year,* 1902."

Mr. F. W. Reader seconded the motion.

These resolutions were put by the President to the meeting, and carried unanimously.

It was announced that to fill one of the vacant seats on the Council the name of Mr. Champion B. Russell had been sent in to the Secretary, and consequently Mr. Russell's name went forward for election at the Annual Meeting.

Mr. Avery exhibited a series of Essex Copper "Tokens" of dates towards the end of the 18th century. The tokens were in a beautiful state of preservation. Mr. Avery described the tokens and made some remarks upon them.

Prof. Meldola laid upon the table a plan of the section of a well at Easton Lodge, recently made. The details were in Mr. Whitaker's hands for incorporation in another batch of Essex Well-Sections now being prepared for publication in the ESSEX NATURALIST.

Mr. W. Cole exhibited a shell of the Swan Mussel (*Anodonta cygnea*) from Mr. Harting's collection, taken with many others from an Otter's haunt, showing that the end of the shell had been bitten off by the otter, and the

molluscan animal abstracted. This went to show that the otter lived to some extent upon mollusca.

Mr. Chalkley Gould exhibited on behalf of Mr. B. G. Cole, a counterfeit Spanish dollar found a few years ago in Epping Forest, which had been presented to the Forest Museum by Mr. Percy Gearing. Mr. Gould remarked that during the reign of George III. the excessive scarcity of silver money led the British Government to attempt to remedy the deficiency by buying Spanish dollars, counter-marking them (on the bust of the Spanish ruler) with the Hall-mark of King George, and issuing them as British coin. As a natural consequence counterfeiting on a large scale ensued, and after two attempts so to utilize the dollars, the Government abandoned the plan ; the entire Spanish impression was obliterated under a powerful press, and the silver was used to coin the well-known Bank of England dollar. The exhibited example of the forged dollar, with the counter-mark of 1797, was found with many others in Epping Forest, near the "Wake Arms," at a spot selected, doubtless, by some counterfeiter who was prevented from recovering the hoard. It is heavily plated with silver upon a copper body. The coin is "Carolus III [of Spain] Dei Gratia, 1773." About 40 years ago a considerable number were found at or near the same spot.

Mr. Frank P. Smith gave a most interesting *viva voce* account of the preliminary portion of his projected series of papers on "The Spiders of Epping Forest." The lecture was illustrated by about 50 lantern slides, many of photographs taken in the open from actual specimens, affording instances of "Aggressive Resemblance" and other facts in the life-histories of spiders. Mr. Smith also explained his methods of collecting and studying spiders, and the precautions necessary in securing photographs.

The President proposed a cordial vote of thanks to Mr. Smith for his admirable lecture, and for the series of papers of which it was the forerunner. He also made some remarks on points in the lecture, more particularly on the instances brought forward of "Aggressive Mimicry" among spiders.

The vote of thanks was passed by acclamation and Mr. Smith replied.

The report of the Club's Delegate at the British Association meeting at Glasgow, Mr. F. W. Rudler, F.G.S., was taken as read. Mr. Rudler was cordially thanked for his report and for his services as Delegate. The Report was printed in the last part of the ESSEX NATURALIST, *ante* pp. 140-145.

A paper on Eolithic Implements from the Plateau Gravel around Walderslade, by Mr. J. P. Johnson was "read" in abstract (in Mr. Johnson's absence through illness) by Mr. A. S. Kennard. The paper was illustrated by specimens and by a few lantern slides. It will appear in the ESSEX NATURALIST.

Mr. A. S. Kennard also exhibited and presented to the Club, some Eolithic stones from the country near Rochester.

Both Mr. Kennard and the President commented on the value of these implements as affording evidence of the existence of man at the time the Plateau gravels were deposited. Mr. Paulson also joined in the discussion. Votes of thanks to Mr. Johnson and Mr. Kennard were passed.

THE TWO HUNDRED AND ELEVENTH ORDINARY MEETING.

SATURDAY, MARCH 22ND, 1902.

Previous to the Annual Meeting an Ordinary Meeting was held, the President in the chair, for the purpose of proposing some candidates for membership, &c.

Mr. Reader exhibited and explained some models of the mode of hafting Flint Implements which he had had prepared for the Museum, and also exhibited two burnishers from Clerkenwell, to show that the use of Stone Implements still obtained in some trades. A description of these models will form the subject of a future "Museum Note."

He also exhibited photographs of a prehistoric mine in Chili, and a model of the mode of hafting blocks of limestone in that mine so as to be serviceable as hammers.

Remarks were made by Professor Boulger and Mr. D. Howard on the chemical composition of prehistoric bronze implements.

Thanks were voted to Mr. Reader for his interesting exhibitions. THE ANNUAL MEETING followed.

THE TWENTY-SECOND ANNUAL GENERAL MEETING.

SATURDAY, MARCH 22ND, 1902.

The 22nd Annual Meeting was then held, Prof. Meldola, F.R.S., President, in the chair.

The minutes of the Annual Meeting, held on March 30th 1901, and printed in the ESSEX NATURALIST, vol. xii., pp. 48-49, were read and confirmed.

The Treasurer, Mr. David Howard, F.C.S., read the summary of the Treasurer's statement of Account for 1901 which had been duly signed by the Auditors, Messrs. Walter Crouch and J. D. Cooper. This statement was received and adopted by the meeting.

The Secretary read the Annual Report of the Council for the year 1901 This was received and adopted.

At the Meeting on February 22nd last, the following members retired from the Council by the Rules:—Messrs. J. Avery, L. Cranmer-Byng, A. J. Furbank, G. E. Vaughan, and the Rev. R. E. Bartlett; Messrs. Avery and Vaughan submitting themselves for re-election. There are also two vacancies remaining over from former years.

At the same meeting the following were duly proposed;—Mr. J. Avery, Mr. Percy Clark, B.A., Mr. Primrose McConnell, B.Sc., F.G.S., Mr. Hugh H. Mason, F.R.C.S., L.S.A., C.C., Mr. G. E. Vaughan, and Mr. C. B. Russell, M.A., J.P., C.C., has since been nominated.

As Officers the following were nominated:—

President—Prof. R. Meldola, F.R.S., F.C.S., F.E.S.; *Treasurer*—Mr. David Howard, J.P., F.C.S.; *Hon. Secretaries*—Mr. W. Cole, F.L.S., F.E.S., and Mr. B. G. Cole; *Librarians*—vacant; *Auditors*—Mr. Walter Crouch, F.Z.S. and Mr. J. D. Cooper.

No other Members having been proposed for any office, the above gentlemen stood elected as Members of the Council and Officers for the year 1902, and were so declared by the Chairman.

The President said that the Council had resolved to recommend eight gentlemen for election as HONORARY MEMBERS of the Club. The resolution passed at the last meeting would permit of the selection of these gentlemen at the present meeting. All had consented to become Members, and he thought that the list would show that it was representative of the different departments of science coming within the scope of the Club's studies. The President then read out the list, which is printed in the Annual Report of the Council.

The election of these gentlemen as Honorary Members was proposed by Mr. E. A. Fitch, and seconded by Mr. G. E. Vaughan, and carried unanimously.

The President nominated as Vice-Presidents during his year of office the following.—E. N. Buxton, J.P., Walter Crouch, F.Z.S., I. Chalkley Gould, and J. C. Shenstone. F.L.S.

Mr. W. Whitaker, F.R.S. proposed that votes of thanks should be given to the officers for their services during the past year. This was carried unanimously.

Mr. David Howard returned thanks for the officers collectively.

The President then delivered his ANNUAL ADDRESS which was entitled "The Coming of Age of the Essex Field Club, a record of Local Scientific Work, 1880-1901." This paper was printed in the last part, *ante* pp., 79-16.

Mr. John Spiller, F.C.S. as an "Original Member" of the Club, had much pleasure in proposing a cordial vote of thanks to the President for his services during the year and for the admirable Address he had delivered, and that the Address be printed in the ESSEX NATURALIST.

Rev. W. C. Howell warmly seconded the vote of thanks.

Mr. David Howard in putting the vote to the meeting proposed that 250 separate copies of the President's Address should be printed off and, circulated as extensively as possible, for the purpose of calling attention to the work of the Club, in the hope of thereby recruiting the roll of membership.

The vote of thanks was carried by acclamation, and Mr. Howard's proposal regarding the extra copies of the Address was agreed to also.

The President suitably responded, and expressed his pleasure at seeing so many old members of the Club in the room to support him in his endeavour to place the 21 years' work of the Club clearly before the county.

The Hon. Secretary presented an account of the "Tea Fund," showing that the receipts had been £4 13s. 6d. and the expenditure £4 18s. 5d.

SPRING WOODLAND AND MEADOW RAMBLE.

SATURDAY, MAY 3RD, 1902.

One of the usual Spring Rambles was arranged for the above afternoon to visit the very interesting woods in the Ongar Park district.

Unfortunately the weather was extremely unsettled, and a severe storm in London prevented many members attending, including three of the

"Conductors." But in spite of these adverse conditions more than 50 members and visitors attended, and Mr. Primrose McConnell, B.Sc., F.G.S., and Mr. I. Chalkley Gould efficiently acted as leaders.

The party assembled at North Weald Station about 10 minutes to 3, and Mr. McConnell at once led the way to the Ongar Park Woods, where the keeper was in attendance.

Ongar Park Woods are portions of the old Forest of Essex, considerably changed by long years of planting and management as game woods. They formed part of the "Purlieus" of the Forest, for the history of which Fisher's *Forest of Essex*, pp., 159-170 should be consulted. Very considerable information respecting the natural history of these woods will be found in the reports of previous visits, in our *Journal of Proceedings*, vol. ii., pp. xliii.-xlvi. ("From Epping to Theydon Garnon") and *Ibid*, vol. iv., pp. civ.-cviii. In the latter report, some editorial remarks on the Purlieus will be found (p. cvii., foot-note). The late Mr. English there gave many details of the entomology of the woodlands, and Prof. Boulger of the botany.

On the present occasion, Mr. McConnell called a halt at the "Eight Wents" and remarked that it was almost exactly 18 years since the Club had visited Ongar Park Woods. The place where they were standing at the moment was the meeting point of eight "Wents" or "Wonts," rides which radiate in straight lines outward like the spokes of a wheel. The Ordnance Map showed that these were at mathematically exact distances from one another; one of the rides, however, had within the last thirty years been allowed to grow up and become obliterated, in the interests of game preservation. The centre point had at one time been occupied by a spruce fir tree—long gone however. The height above sea level of this centre point was 340 ft., so that it was thus the third or fourth highest point in Essex.

Ongar Park Wood was a remnant of the ancient Forest of Essex, and was continuous with Epping Forest, though now for many generations it had been private property. The district of Ongar Park was one of the seven "Purlieus" of the Forest of Waltham (which included what is now Epping Forest) and the name was common to several of the present day farms and woods of the neighbourhood– such as the speaker's own farm, Ongar Park Hall, also Ongar Park Lodge, Ongar Park Grove, etc.

The prevailing timber tree of the Wood was hornbeam, but many other species were quite common, and some specimens of the Wild Cherry (*Prunus cerasus*) and of the American locust-tree (*Robinia pseudacacia*) were to be found.

The late Mr. English had collected some specimens of rare moths—such as the "Camberwell Beauty" and the "Great Emerald," in these rides in bygone years.

The geological formation of the ground over which they had come was largely Glacial Drift on the top of the London Clay, with small patches of the Chalky Boulder Clay of East Anglia. The surface soils were thus composed of the corresponding gravelly, marly, and clayey material; the two first being the basis of most of the arable fields in the neighbourhood, while the clay is mostly in permanent grass land. The heathy portion they had crossed was given on the Geological Survey map as "Pebble Gravel."

As the party were to have tea at Toot Hill it was interesting to note the origin of the name of this little country hamlet "Toot" or "Taith" was the name of a Norse Goddess, and the word was quite commonly applied to places, as for instance at Tooting, Tooter's Hill, Tottenham, and so on, and it indicated where there had been village settlements in the times of the Vikings.

Unfortunately the rain began soon after Mr. McConnell's address and all investigations in the woods was stopped. The party was obliged to press forward over the field-paths to Toot Hill. By the way, Mr. Chalkley Gould pointed out that the trenches were still quite distinct which had enclosed the rectangular piece of ground where are now the cottages and gardens of Toot Hill. The site commands a good view round three sides and across the Roding valley.

The party reached the "Green Man" in a sharp shower. But an excellent tea soon comforted everybody. Then an Ordinary Meeting, the 212th, was held for the election of new members, Mr. J. Chalkley Gould, *Vice-President*, in the chair.

The following were elected members of the Club :—

Messrs. Edward Chichester, M.B. (London), Francis Dent (Hon. Sec. Essex Bird Society), James Dietrichsen, (Mrs.) Dietrichsen, (Miss) Blanche Hewett, B.Sc., Ernest C. Horrell, F.L.S. (Staff Instructor in Biology, Essex County Council) John F. Rogers, Frank Sulley, William White, F.E.S., and Edward Wilshaw.

After the meeting, the rain having ceased, the ramble was continued by very pleasant meadow-paths, and through an old disused lane, which was stated to have been an ancient pack-horse road leading to the church. In the lane and meadows the cowslip was extremely abundant, and many other interesting plants were noticed. And then the antique wooden church of St. Andrew's was reached, and carefully examined under the guidance of Mr. Chalkley Gould. The Club visited Greensted Church on the first Field Meeting held (March 29th 1880) when the late Captain Budworth acted as guide (see *Journal of Proceedings*, vol. i., p. viii.) and in the report details of the construction of the Church will be found. It is one of the oldest Churches in the world, and the nave is probably the only example of a Saxon wooden Church which has come down to us.

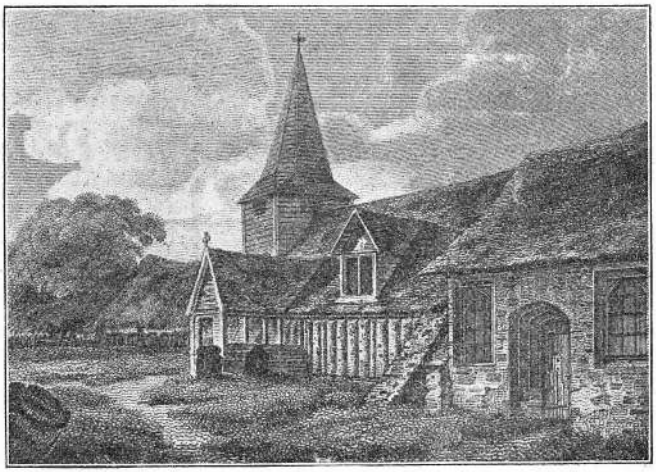
In the dusk of the evening the company seated themselves in the ancient building whilst Mr. Gould gave a eloquent lay sermon on the partly legendary life of Edmund, the saintly king of East Anglia, a story which from its local and quaint interest may be summarised here :—

"England in the middle of the 9th century was still split up into petty kingdoms, or sub-kingdoms, under the house of Wessex, that known as East Anglia including the present counties of Norfolk, Suffolk and part of Cambridgeshire. Of this kingdom, Edmund, a boy of 14 years, became ruler in 855 and 856[1] and the decade which followed shewed him to be pious and studious, though not the less a sportsman and a warrior.

[1] It is recorded that the northern portion of East Anglia recognized his kingship in 855, the southern part not until the following year.

"In the years succeeding the date of his coronation, East Anglia could boast of peace and prosperity beyond that of the other Saxon kingdoms, but the shadow of the terrible Northmen's raven soon caused gloom throughout the land, and in 865 the shores of England were invaded by 20,000 pagan Danes. I may not occupy your time with the story of the next five or six years but pass to the sad year A.D. 870, when East Anglia's dauntless Christian king vainly fought the pagan host. Chronicles of the mediæval monks tell how boldly the king, then 29 years old, bore himself before his conquerors and persecutors.

"The final scene was enacted on a gloomy November day in the Forest of Eglesdune (now represented by Hoxne, near Eye in Suffolk). Here the pagan savages bound the king to an oak tree, scourged his body and made him a target for their iron-tipped arrows, finally cutting off his head.



Greensted Church, near Ongar.
(*From a Print dated* 1809. *Block lent by Mr. A. Lockyer.*)

"The story goes on to tell that when the Danish host had gone thundering on to further pillage, the body was sought for by Christian Saxons, that they found it in an open clearing, but discovered not the head till in the depths of the forest they heard a voice as of the king cry "here! here! here!" And there they saw a strange sight--a great grey wolf crouching down with its paws expanded and between them the head of the monarch! Peacefully giving up possession, the wolf retired and the mourning Saxons gave the remains burial near the forest.

"There the body rested for 33 years, till in A.D. 903 it was translated to Beodricsworth, the place afterwards known as St. Edmund's Burh, now Bury St. Edmund's, where it remained peacefully for over 100 years.

"Many stories of miracles connected with St. Edmund's body are to be read in the chronicles and numerous were the people who flocked to and enriched the shrine and monastery, but in A.D. 1010 the hordes of Turchil the Dane landed near Ipswich to pillage the fair Saxon country-side, and then dreading lest the priceless relics should fall a prey to the invaders, a monk conveyed them to London (sundry miracles helping him on the way).

"Peace came to England, and in 1013 the third translation took place, though Alphum, Bishop of London, hotly fought to retain the holy bones in the city. The body of the king was conveyed in solemn procession to Bury St. Edmund's and here our local interest begins, for the monks travelled by an ancient way (now mostly dwindled into bridle-roads and footpaths) which led from the Roding valley here, and hence to Clare and Bury. Here, where St. Edmund's remains rested for some days, pious hands are said to have erected this rude wooden Church; but personally I think it probable the building was here already, for Greensted was an old-time village on the king's highway when the road through Ongar did not exist and Ongar was but a little settlement on a cross road. As such it remained till Eustace of Boulogne held it under the Conqueror, and Richard de Luci made it his home in the days of Henry II.

"That however, is another story. Our interest is in the timber nave of this little church, associated as it is with the romantic journey of the remains of Edmund; and long may its timber walls stand a lasting memorial of East Anglia's king, martyr and saint."

The evening was still stormy as the party traversed more pretty meadow paths to the little station at Blake Hall.

VISIT TO WALTON-ON-NAZE AND FRINTON, ESSEX.

SATURDAY, JUNE 7TH, 1902.

The stormy and unsettled state of the weather during the previous few weeks had rendered it undesirable to hold any meetings, especially on the coast. But on this day a visit was made to the picturesquely situated towns of Walton and Frinton in order to view the fast diminishing exposures of the celebrated Red Crag formation, and to study the rapid denuding action of the weather and sea on the soft cliffs of this part of the coast. As the programme said "it would be a startling object-lesson in geology."

The Club has visited Walton on two previous occasions; first on September 14th, 1889 (ESSEX NAT. iii., 230-32) when the late Dr. Taylor was the demonstrator, and again on June 7th, 1890 (E. N. iv., 129-32) under the guidance of Mr. Whitaker and Mr. Holmes. In the reports of these meetings much information on the topography and geology will be found. The literature on the geology of the neighbourhood up to the end of 1888 is catalogued in the "List of Works on the Geology of Essex," pp. 61-86 of vol. iii. of the ESSEX NATURALIST. The maps are Geol. Sur. Map 48 S.E. with adjoining part of 48 N.E. and 48 S.E. with accompanying memoirs to these

sheet by Whitaker and Dalton. And in 1890 Mr. W. H. Dalton wrote for the Essex Field Club "A brief sketch of the Crag Formation of East Anglia. An outline of the Nature, Position etc., of the Beds which have furnished the Collection of Crag Fossils in the Essex Museum of Natural History," a valuable little pamphlet, giving the latest aspect of the subject.[2]

On the present occasion, Mr. W. H. Dalton F.G.S., and Mr. T. V. Holmes, F.G.S. were the "Conductors," and we had also the benefit of the company of Mr. J. E. Greenhill who had been staying at Walton for some little time. Unfortunately the stormy weather much restricted the party, which assembled at about 1 o'clock at the "Royal Albion" Hotel for luncheon. Afterwards a walk along the foreshore was taken to inspect the sections of the London Clay and the Crag, but very soon the rain came down and observations had to be taken under the shelter of umbrellas Mr. Dalton, was, however, able to demonstrate most points of interest, and a few fossils were collected, although the wet and "greasy" state of the cliffs rendered climbing somewhat unpleasant and at times unsafe. The geological and topographical observations made are embodied in Mr. Dalton's special report in the present part of the ESSEX NATURALIST (see pages 217-21). As the afternoon wore on even the euthusiasts were compelled to beat a retreat to the inn, and to ward off the damp with a cup of warm tea.

Afterwards an ORDINARY MEETING (the 213th) was held, the President Prof. R. Meldola, in the chair.

The following were elected members of the Club:—Mr. W. H. Ault, Rev. Henry E. Bird, Rev. Father Clements, Mr. H. W. Lewer, Mrs. Lewer, Mr. H. T. Malby (F. Roy, Photo. S.) and Mr. Elliott Sparks.

Mr. Picton exhibited a Neolithic Celt found by one of his pupils on the beach at Clacton. Although Palæolithic Implements have been found at Clacton, there appear to be no records of Neolith Celts in that neighbourhood. A figure of this implement will be given later in our journal.

Mr. Henry Mothersole exhibited a Neolithic Implement from the gravel-pit in "Admiral's Park" Chelmsford, whence Mr. H. Corder obtained the fine spear-head many years ago which was recorded and figured in the "Transactions" of the Club (*Trans. E.F.C.*, vol. ii., p. 29, pl. ii.) Mr. Mothersole's implement, with other Neoliths from the neighbourhood of Chelmsford, will be figured in a future part.

Mr. Mothersole also exhibited and presented to the Museum, a few flint flakes and "scrapers" gathered that morning on the shore at Walton, from the spot near which Dr. Laver and Mr. Spalding had found so many implements (see ESSEX NATURALIST, vol. ii., 187).

A short discussion took place on the subject of the erosion of the East Anglian coast, and Mr. Holmes read some notes from the British Association Report on Coast Erosion which he had extracted for the purposes of the meeting. These are embodied in the notes on Coast Erosion in another part of the present issue (see pp. 221-24).

Towards the evening the ramble was continued along the cliff to the pretty modern village of Frinton. Mr. Dalton had no difficulty in strikingly demonstrating his remarks—Frinton has suffered in an extraordinary degree from coast erosion—the site of the old Frinton Hall lying half-a-mile out at sea, and

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it is quite evident that the heroic attempts now being made by the authorities to arrest the decay of the land will be abortive.

Time did not allow of an inspection of St. Mary's Church, almost the smallest in England; the chancel, blown down in the great storm of 1703, was restored in 1879. On the way to the station, the Marconi Company's "wireless" telegraphic stations now erected at Frinton was seen with interest. A few members of the party remained down at Walton for the Sunday.

THE OAK GALLS AND GALL INSECTS (CYNIPIDÆ) OF EPPING FOREST.

By E. J. LEWIS, F.L.S., F.E.S.

[*Read January 26th, 1901.*]

The study of Galls and Gall-Insects has never attracted the amount of attention that so interesting a subject deserves, although it affords a wide field for inquiry both to the entomologist and the botanist.[1] Galls occur on a great number of plants, and are caused by a variety of creatures, not only insects but also by mites and worms. Among the worms we find such species as *Tylenchus tritici* (Bastian) which belongs to the family Anguillulidae, or Eel-worms, forming galls known as "Ear-cockles," or Wheat Eel-worm Galls. The family Eriophyidæ (Phytoptidae) contains many species of gall-forming mites, those red formations so often seen in great numbers on the leaves of the maple and sycamore being examples. The swollen buds so prevalent on the black currant bushes are due to the presence of a species of mite, *Eriophyes ribis* (Nalepa), belonging to this family, thousands of individuals being present in each bud, and now doing such an enormous amount of damage that non-infested bushes are becoming the exception. An allied form, *E. avellanae*, is commonly met with on the hazel, causing the buds to swell in the same way. Other species (*E. taxi* (Murray) and *E. rudis* (*typicus*) (Cam.)) affect the buds of the yew and birch, respectively, in a similar manner.

Gall-makers are included in several different orders of the Insecta. For instance, the turnip gall weevil (*Ceutorhynchus sulcicollis*), which produces swellings on the turnip and on the

1 Readers will find much information not only with regard to the galls of our county, but also on the general subject, in Mr. E. A. Fitch's paper on "The Galls of Essex," *Transactions Essex Field Club*, vol. II., pp. 98-156. In this paper wood-cuts are given of many of the oak-galls formed by the Cynipina, as well as those on other plants made by Coleoptera, Diptera, Hymenoptera, &c. Mr. Fitch also gave abundant bibliographical references. Ed.

stalks of the cabbage, belongs to the order Coleoptera (beetles). In the order Diptera (true flies) gall-making species are found chiefly, but not entirely, in the family Cecidomyidae, an example being the hairy nail-gall, *Hormomyia piligera*, found on the upper sides of the leaves of the beech. In the order Hemiptera we have the family Aphidae including such species as *Chermes abietis*, which causes the common but remarkable cone-like gall on the Norway spruce, and *Schizoneura ulmi* which forms a gall on the elm. The order Hymenoptera includes the family Tenthredinidae (sawflies) some of which form well known galls on the leaves of various willows. To this order also belong the Cynipidae, which produce galls on the rose and other plants, but chiefly upon the oak. There are many other gall-makers besides those which I have enumerated, but in the following record I am dealing only with those Cynipids which form galls upon the oak.

Cause of the formation of Oak-Galls.

A gall is a peculiar growth of the tissue of a plant due to irritation set up by some internal animal agency. This irritation acts upon the cambium layer of the plant in which the gall-maker lays its egg. The abnormal formation is not due to any poison injected by the insect at the time of oviposition, but the egg must be laid in the cambium ring, or growing meristamatic tissue of the plant, in order to form a gall. Morbid growth results either from irritation caused by the swelling of the egg after oviposition and the subsequent hatching of the larva, or more commonly by the latter alone, in which case the gall does not commence to form until the larvae have emerged. Growth of a gall only occurs while the juices of the plant are active, no growth taking place in the winter.

The gall-makers themselves are usually small and insignificant looking insects, but the galls which they form differ greatly both in size, shape, colour and texture. The position in which they appear on the tree also varies as they may arise from the buds, leaves, stems, or roots. In the centre of each gall there is a hollow cavity in which the larva feeds and grows, subsisting on the juices of the surrounding tissue; here it pupates, the perfect insect subsequently boring its way out through the side of the gall, the hole thus formed being in many cases exceedingly small compared with the size of the insect. The hole

forming the means of exit for some small parasite may often be mistaken for that of the gall-maker.

Parthenogenesis and Alternation of Generations.

Alternation of generations is an exceedingly interesting feature occurring in the life history of those Cynipidae forming galls on the oak. There are two generations a year, the first, consisting of females only, is known as the Agamic generation, the second, which includes both males and females, as the Sexual generation.

The two generations give rise to galls which may differ entirely both in shape, size and situation.

Those galls which mature in the spring give rise to insects comprising females only, which proceed to lay fertile eggs without having any connection with a male. This is known as Parthenogenesis or reproduction without male agency, the generation of flies being Agamic. After these have oviposited in the spring, galls arise which mature in the summer, and the insects emerging from them comprise both males and females (sexual generation); the latter, after copulation, lay eggs which in turn eventually cause galls to form which are exactly similar to those from which the agamic generation emerged in the spring. The reason for this alternation of generations is not known, and it would take too long to discuss the various theories on the subject, but it seems to be intimately connected with the extrusion of the polar bodies during the germination of the egg, previous to the formation of the embryo. In the eggs of the sexual generation two polar bodies are extended, while in the eggs laid by the agamic generation only one polar body is extruded.

In all lower forms of life we find the occurrence of parthenogenesis more common than in the higher forms. As regards the Cynipidae there are a few species forming galls on the oak which have only one generation a year, this generation being agamic. It is probable that these and other agamic generations at one time possessed males, as we find cases among the Cynipidae forming galls on other plants where a few males are still present.

For instance, in the case of *Rhodites rosae*, which forms the common "Bedeguar" or Pincushion-gall on the rose, the males are almost extinct, though a few are still found; consequently

reproduction has become parthenogenetic, owing to a gradual loss of males, there being only one generation a year. It is probable that the process has been equally slow in other forms, but is so far advanced that only females are known. In *Rhodites rosae* we may conclude that males will soon be quite as extinct as they at present are in the agamic forms of oak gall-makers. Again, the receptaculum seminis is present both in the agamic and sexual generations, though atrophied in the former. Unless this can be explained by its being inherited in the agamic generation from the sexual, but being functionless has gradually become atrophied from want of use and may eventually disappear, it seems to point to the fact that males were present at some remote period. Before copulation can take place the ovipositor of the female must be extruded. Copulation takes place soon after the insects leave the galls, and the females sit with the ovipositor extruded awaiting fecundation. But this extrusion is carried out by the females of the agamic generations also, though they have no males to fecundate them and reproduce parthenogenetically. Does not this apparently prove that these agamic generations at one time had males, or could this act come under the head of inherited instincts?

Some galls, especially bark galls such as *Andricus radicis*, require two years in which to complete their generation cycle. The rudiment of the gall is formed in the first year and further development is arrested till the following spring, when the gall formation is renewed with a fresh period of vegetative activity. Maturity is reached in the autumn, the flies emerging in the spring of the next year. These lay eggs in the buds, which give rise to the sexual generation (*A. trilineatus Htg.*) which in turn oviposit to form the *A. radicis* gall. Galls formed by the brood appearing in the spring take a much shorter time to reach maturity than those formed by the sexual generation.

Insects of the agamic generation appear in early spring often in very cold weather, some forms, such as *Biorhiza terminalis*, frequently ovipositing during the winter, when the snow is on the ground and the temperature at freezing point; consequently it is a good thing for them to be able to lay their eggs at once, without previous connection with a male. The sexual generation on the other hand appears in the summer when the weather is warm, live longer, and so have more time to spare for the process of continuing their species.

Gall variation.

As before mentioned galls of different generations of the same species often occur on different parts of the oak besides varying in shape and colour, etc. Galls of the agamic generation, *Dryophanta folii*, the common Cherry-galls of the oak, occur on the back of the leaf while the corresponding galls of the sexual generation, *D. taschenbergi*, usually arise from adventitious buds situated on the trunk of the tree. The former when mature are large, round, yellowish galls, often with a red cheek, the latter are very small velvety galls, purplish in colour, hardly noticeable against the bark.

The great difference between the galls as they occur on the oak, and the similarity existing between the insects which form them, is very marked. The larvae are fleshy, legless grubs, usually white or yellowish in colour. The perfect insect is, as a rule, brown or black, and it is almost impossible to find sufficient variation to differentiate between the species in some cases. Those agamic forms having only one generation a year, such as *Andricus quadrilineatus* and *A. seminationis*, are practically identical, and yet the galls are very different. This may be accounted for by the fact that the larva is surrounded by the gall tissue throughout its whole life, and is never exposed to the light, so cannot be acted upon in any way by external influences, and consequently varies but little. The perfect insects live only a short time and die as soon as the eggs are laid. The galls on the other hand serve to protect the larvae from parasites, and are, therefore, greatly modified by external conditions.

Inquilines and Parasites.

The number of parasites and inquilines preying on the gall-makers and living in their galls is enormous. They are of three kinds:—

Inquilines or "guest-flies" which live in the thickening of the gall substance, doing no harm to the hosts.

Inquilines which do not directly prey upon the host but starve it out and take up the extra room thus obtained for their own benefit (including certain Synergidæ in the galls of *Cynips kollari*.)

Direct parasites preying on the larvae, such as Chalcididae, Ichneumonidae, and Braconidae.

There are also insects of various orders which feed upon the substance of the larger galls such as *Biorhiza terminalis*. They are known as "commensals."

On account of the number of parasites, inquilines, etc., found in oak galls, it is important to differentiate between them and the true gall-makers :—

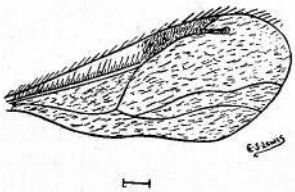

Fig. 1. Wing of a Chalcid.

Characters of the Chalcididae. Wings without a system of cells, having a single nervure proceeding from the base near the costa to which it afterwards passes after giving off a short vein more or less terminally thickened. (Fig. 1.) The angles of the pronotum do not extend back to the point of insertion of the tront wings. Antennae elbowed, with seven to thirteen joints.

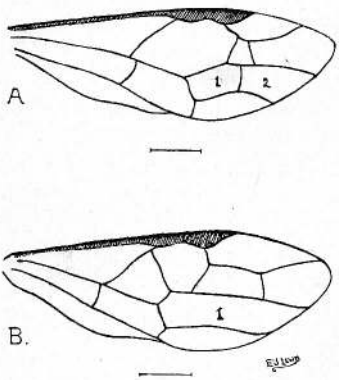

Fig. 2 *A*. Wing of an Ichneumonid.
B. Wing of a Brachonid

Characters of the Ichneumonidae. Wings with a system of cells well developed. The space in the front wing dividing the posterior cell from the cubital cells, is separated into two portions by a transverse veinlet. (Fig. 2 *A*. Antennae many jointed. Abdomen attached to the lower part of the medium segment,

Characters of the Braconidae. Wings with a moderate number of cells. The anal or second posterior cell is separated from the cubital cells by a large space having no cross nervure. (Fig. 2 *B*.) Antennae not elbowed, nearly always more than fifteen jointed. Abdomen with little mobility between the segments, the suture between second and third usually absent.

Characters of the Cynipidae. Wings with few cells and having no stigma. Pronotum fixed to the mesonotum, the angles extending back to the points of insertion of the front wings. (Fig. 3 *A*.) Antennae straight, composed of twelve to fifteen joints.

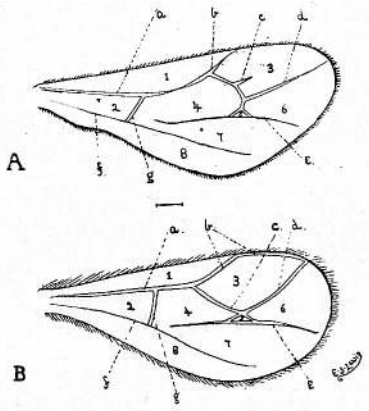

Fig. 3. *A*. Typical *Cynips* Wing. *B*. Typical *Synergus* Wing.

Nervures.	*a.* *b.*	Sub-costal	*e.* Cubital		
	c. *d.*	Radial	*f.* Median		
			g. Transverse basal		
Cellules.	1	Humeral	4	Areolet	Cubitals
	2	Median	5		
	3	Radial	6		
			7	Discoidal	
			8	Posterior	

Besides the true gall-makers there are other genera of the Cynipina which live as Inquilines in various Cynip galls. Such genera are :—

(1.) *Synergus*: This is represented in nearly all oak galls.

(2.) *Ceroptres*: Occurring chiefly in *Andricus trilineatus* galls.

(3.) *Sapholytus*: In galls on *Quercus cerris*.

The Synergidae have the radial cellule of the wings closed, but in the Cynipidae the subcostal vein is not continued along the front margin. In this way they can be easily distinguished. (See Fig. 3.)

Parasites attacking gall-making insects belonging to the Cynipina are chiefly members of the family Chalcididae. These are small blue or green-metallic coloured Hymenoptera preying upon both larvae and pupae, the same species being often found in different galls.

Ichneumonid and Braconid forms, parasitic on the Cynipid oak gall-makers, are not numerous.

Parasites often prey upon the larvae of Inquilines. Certain Cynipidae are parasites upon other insects, such as Aphidae, and are sometimes found in the galls of members of their own family.

Parasites reproduce themselves sexually. Agamic forms, are, however, found among Inquilines, the genus *Ceroptres* furnishing examples of both kinds.

Protection against Parasites.

Various devices for the protection of the larvae against these intruders are consequently necessary, and it is on this account to a large extent that galls present such a variety of form and structure. Hairs may be produced in abundance on a gall, as in the case of *Andricus ramuli*, where it is covered with a dense white matted growth, or a few stiff hairs may be present (*Neuroterus tricolor*). In *Andricus fecundatrix*, the gall is completely imbedded in an abnormal growth of scale leaves, giving it the appearance of a hop. A covering consisting of the phloem or bast cells of the peripheral layer protects *Andricus corticis* galls. In the case of *Andricus sieboldii*, the gall secretes a sweet sticky substance, of which ants are very fond, and these latter insects often protect the galls with a hood of earth. A hard woody growth near the centre of the gall serves as an extra means of protection to the larva in the case of *Cynips kollari*. In other cases the larva may be enclosed in a separate cocoon within the gall (*Andricus curvator* and *A. inflator*). The substance of the gall may be very bitter and obnoxious to birds which peck at it to get at the larva within (*Cynips kollari*). Other galls are highly coloured as a warning to birds (*Biorhiza terminalis*). The most interesting form of protection is that of "Protective Resemblance" where galls take the likeness of buds so accurately that even when specially searching for the galls one is liable to pass them over without notice (*Andricus albopunctata*). Parasites often distort galls either by stunting them or causing them to swell. I

have often found *Andricus fecundatrix* galls rendered polythalamous by a number of contained Synergid larvae. Some galls, such as *Andricus collaris*, which naturally fall to the ground during late autumn, will remain on the tree when attacked by parasites.

The common oak Marble-gall (*Cynips kollari*) may often be seen of smaller size and darker colour than is normally the case. On cutting through one of these galls it will be noticed that instead of there being one cell only in the centre of the gall, there is a ring of cells present. These have been formed by Synergid larvae and they will be found to have filled up and eliminated the cell of the original gall-maker.

Cynips kollari galls often have knobs or excrescences upon their surface which are caused by inquiline larvae living in the gall substance. *Biorhiza terminalis* galls (the common "Oak Apple") are particularly liable to parasitic infestation and are inhabited by a great number of insects. As many as seventy-five species have been collected from these galls, besides Acarina and Araneida.

Although some changes in the appearance of a gall, such as those mentioned with regard to *Cynips kollari*, are due to parasitic infestation, they are for the most part probably caused by some substance secreted in the salivary glands of the larva, which acts upon the surrounding tissue, on the juices of which the larva feeds. This would account for the remarkable variety in form, etc., shown by the spangle-galls of the genus *Neuroterus*, since the method and time of ovipositing are in each case apparently the same.

Oviposition and growth of the Gall.

The piercing apparatus of a gall-fly is, as one would expect to find it, of somewhat exceptional construction, the act of oviposition being of extreme importance with these insects. The ovipositor and its attachments take up practically the whole of the interior of the abdomen when in repose.

The plates mentioned below are paired and the whole apparatus is worked by five muscles.

It is made up of:—An anterior plate, a posterior plate and a triangular plate.

The anterior plate (Fig. 4, *d*) is attached to the lower end of the triangular plate (*c*) and the base of the posterior plate (*e*).

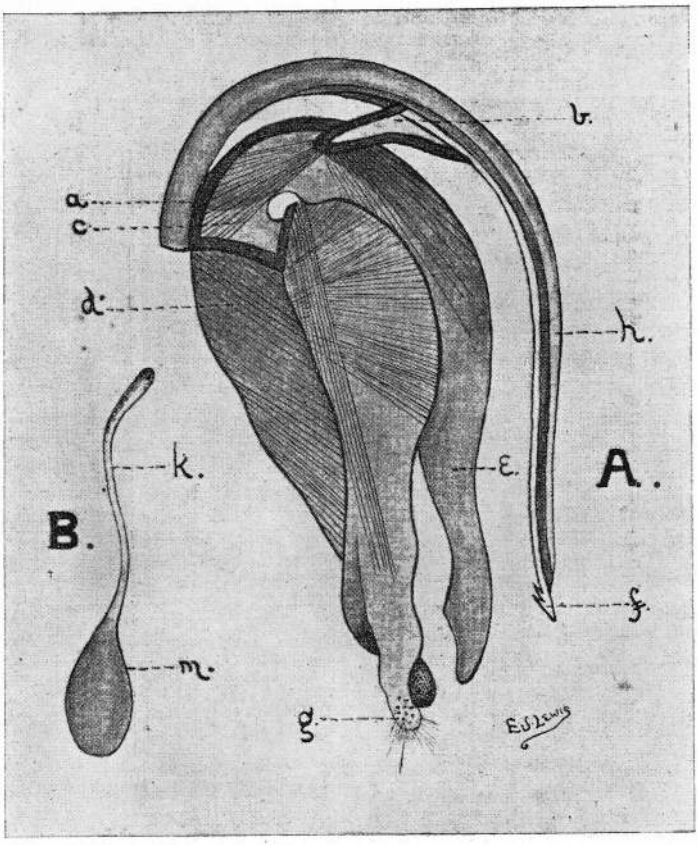

Fig. 4 *A*. Ovipostor of a Gall-insect *Dryophanta* (× 30).
B. Egg of a Gall-insect.

a. Apical
b. Basal } attachment of support
c. Triangular plate
d. Anterior plate
e. Posterior plate.
f. Spiculæ
g. Anal papillæ
h. Sheath
k. Egg stalk
m. Egg body.

It is narrowed toward the apex at which is situated the papilla (*g*).

The posterior plate (*e*) is also narrowed towards the apex and broad at the base.

The sheath (*h*) is made up of two pieces which together form a groove in which the two spiculæ, or boring apparatus proper, can move.

These spiculæ (*f*) are attached to the triangular plate and are usually toothed at the apex.

The five muscles which are attached to the plates act on the posterior plate by contraction and expansion, giving the spiculae a backward and forward movement.

The egg itself consists of a round egg body (Fig. 4, *m*) which eventually contains the embryo, and a long stalk-like process (*k*) which is useful in two ways. During the process of oviposition the egg body is not sent down inside the ovipositor, but the egg-stalk is clasped and carried down by the two spiculae, the main portion of the egg remaining outside, as the groove inside the sheath is not large enough to admit it.

In the case of such galls as *Biorhiza terminalis*, when the egg is laid in the bud, a passage is first formed by the insect down to the cambium layer. The egg, when it reaches the extremity of the ovipositor, is not detached from the spiculae, but the egg body is placed at the mouth of the groove formed in the bud from which the ovipositor is partially withdrawn and pushed down until it reaches the cambium layer. The ovipositor is furnished with a number of tactile hairs whereby the insect is kept informed, as it were, of the progress of the egg to its proper destination.

Besides acting as a means of attachment to the spiculae by which the latter can seize the egg, the egg tube is also used as a respiratory organ whereby oxygen can be admitted to the embryo developing in the interior of the embedded egg body. For this purpose it is left lying in the canal formed by the insect previously to the deposition of the egg. One insect may lay from six hundred to seven hundred eggs, and oviposition may extend over a period of three or four days. As before mentioned the egg must be laid in the cambium layer, which envelopes the whole of the plant and represents the growing zone. Eggs laid in winter buds are particularly liable to failure,

as the cambium ring is only represented by a thin layer at the base of the bud; consequently in many cases no gall is formed because the eggs have not been placed exactly in this growing zone. The cell growth after the emergence of the larva is sometimes very rapid, in some cases it commences before the larva is quite free from the egg. In the case of *Trigonaspis renum* a period of months elapses after the egg has been laid before gall formation commences. The probable cause of the differences in size and form, etc., existing between various galls has already been referred to, but besides having some property in their saliva which acts on the surrounding tissue, the different ways in which the larvae feed may also have some important bearing on the case.

The general characteristics of the Family Cynipidae.

Antennae twelve to fifteen jointed, never elbowed.

Legs have the trochanters biarticulate.

Wings without a stigma. One radial cellule. One to three cubital cellules. Submarginal nervure absent.

Prothorax reaching at the sides to the insertion of the wings.

Abdomen pedunculated and compressed.

No cocoon spun by the larvae, which are apodal.

Eggs stalked.

The Cynipidae are divided into five Sub-Families:—

(1.) The Ibalina, containing a single genus *Ibalia* including one species, which is parasitic on *Sirex*.

(2.) Allotrina, containing two genera, *Phaenoglyphis* and *Allotria*, parasitic on Aphides or on the parasites of Aphides.

(3.) Encoelina, containing genera which include species parasitic on larvae of various insects, especially Diptera, such as *Musca*, *Eristalis*, *Tachina*, etc.

(4.) Figitina. This sub-family is divided into three sections, Anacharides, Onychides and Figitides. The Onychides are chiefly parasitic on Beetle and *Syrphus* larvae, while the Figitides comprises genera (such as *Figites*) which contain species parasitic chiefly upon Diptera, mostly dung-flies of the family Sarcophagidae.

I have mentioned the above sub-families of the Cynipidae merely to show how very generally parasitic the members of the

family are, though they are of little or no importance to us in our present paper.

The fifth sub-family of the Cynipidae, namely the Cynipina, contains the gall-making insects and the Inquilines living in their galls, and includes all the oak-gall making species.

The following are the chief characters of the sub-family, Cynipina :—

Wings with the areolet opposite to, or not much beyond, the base of the radial cellule, which is usually elongate. The three cubital cellules are as a rule complete. The cubitus arises from the middle of the transverse basal nervure.

Legs with two spurs on the hind tibiae, no processes on the hind tarsi.

Scutellum punctured, wrinkled or alutaceous.

Hypopygium acute or ending in a hairy projecting point.

Basal Segments of the abdomen not subequal or subsessile; the second abdominal segment much longer than the others, not unusually half the length of the abdomen.

Ovipositor spiral or semi-spiral.

The *Egg* has already been described and figured.

The *Larva* is apodal. Thirteen jointed, fleshy, and white to yellowish in colour. Larval life varies much in duration in different species, from about a month to as much as three years.

The *Pupa*, like the larva, is yellowish white in colour and is never enclosed in a cocoon.

The Perfect Insect. (Chief general characters given above.)

(1.) Mouth parts. *Labium* fleshy, truncated or with a curved top. Mandibles short, broad and toothed. Inner lobe of the *maxillae* obsolete. Outer lobe broad and fleshy.

Labial palp 2-3 jointed.

Maxillary palp 4-5 jointed.

(2.) *Antennae*. These differ in the males and females, being longer and thinner in the former.

(3.) *Wings*. Not always present. Seldom longer and sometimes shorter than the body. Hairs may be present on the surface and round the margin. When present the wings are four in number and membranous.

(4.) *Thorax*. This is well developed. The pro-thorax laterally reaches the tegulæ, the pleural region being specially prominent. In front the pro-thorax is but slightly developed, bearing, however, a keel which is often incised presenting two tubercle-like bodies. The parapsidal furrows are often absent from the meso-thorax, when present they may be complete or incomplete.

The *scutellum* may be shining or opaque and varies much, having either one or two basal foveae. It usually overhangs the meta-thorax and median segment.

The *meta-thorax* is very small, though the pleural and sternal regions and the meta-notal stigma are quite distinct.

(5.) The *median segment*, though in reality the first abdominal segment, forms in the Cynipina and other Hymenoptera, a fourth thoracic segment. It is, as it were, separated from the abdomen by the petiole, and is often confounded with the meta-thorax. In reality the petiole is the second abdominal segment. The stigma of the median segment may be larger, foveate or reticulate.

(6.) *Legs*. Of moderate size. *Trochanters* bi-articulate. There are either one or two spurs on the fore tibiae, and on the hind tibiae there are two unequal spurs. The *Meta-tarsus* is long and the tarsi are four-jointed.

Claws may be simple or cleft.

Patella seldom conspicuous.

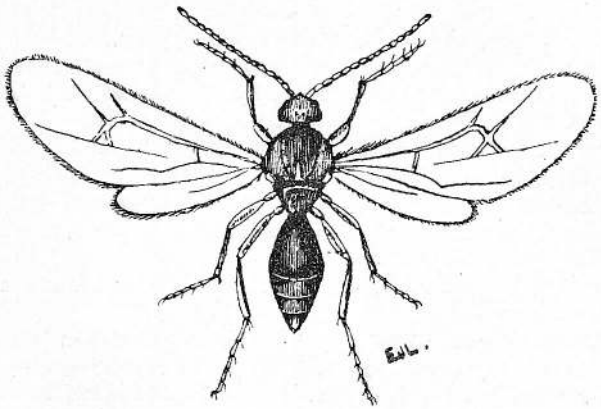

Fig. 5. *Andricus collaris* (Htg.) Perfect insect, magnified. An example of the Sub-Family Cynipina.

(7.) The *Abdomen* varies much in form. It may be slender or thick, long or ovate. Sometimes it appears to be nearly sessile, which is due to the shape of the patiole.

According to Cameron there are seven abdominal segments, which differ in length, especially the second and third, a point much used in classification. The apical ventral segment may be ploughshare shaped. The number of segments in the abdomen differs with different authors according to whether they consider the medium segments or the petiole to be the first abdominal segment. In reality the median segment is. If this latter view is taken the abdomen consists of eight instead of seven segments, the varying segments being the third and fourth. There are only six visible segments on the ventral region of the female, and five in the male.

The *Ovipositor*, which has been previously described, has its origin close to the base of the abdomen.

These gall-makers are usually small insignificant looking insects, their colour varying as a rule from black to brown. This, however, is not always the case, as in some species, such as *Biorhiza terminalis*, the general colour is a light yellowish red, while the abdomens of the *Trigonaspis crustalis* gall-flies are a bright red. As a rule the abdomen is glabrous and shining, but in the genus *Cynips* it is pubescent.

The colour in males and females scarcely differs at all. They are very sluggish insects and when disturbed feign death, tucking their legs and wings close to the body and falling to the ground.[2] Many parasitic species frequent flowers, but gall-makers are only known to take water. It is often difficult to distinguish between the species and sometimes it is impossible except from the galls.

Genera of the Sub-Family Cynipina, which occur as Inquilines in Oak Galls:—

Genus *Synergus*. (The chief characteristics and habits have already been given). The third and fourth true abdominal segments are amalgamated, the suture being rarely visible. The antennae of the male are 15 jointed and in the female 14 joints are present; the male also has the third antennal joint curved and sometimes enlarged. The parapsidal furrows are complete. There are two parallel keels on the medium segment. Claws cleft. One of the chief differences between these insects and the oak gall-makers is the closure of the radial cellule in the former.

They may be separated into two divisions (1) Those ovipositing in autumnal galls, leaving them early in the spring and (2) those depositing eggs in spring galls, leaving them in July. The former include the following species:—*Synergus melanopus*, *rheinhardi*, *tscheki*, *tristis*, *vulgaris*, *incrassatus*, *nervosus*, *pallicornis* and *thaumacera*. The latter division contains *Synergus albipes*, *faciates*, and, according to Mayr, *thaumacera*, which latter he says has been bred from the galls of *Biorhiza renum*.

2 "Feigning death" is an expression commonly applied to this habit in insects and other creatures, but surely it is an incorrect one. Does an insect, when it dies, fold up its limbs in this way, and why should a living one feign death at all?—the fresh morsel whether alive or apparently dead would probably be equally welcomed by a Tit or Creeper in search of breakfast. Is not the habit rather a very effective form of concealment (as we think Prof. Poulton has somewhere hinted) enabling the insect to escape notice by its close resemblance in this attitude to the soil or to some inanimate object? Anyone who has collected by beating branches of trees over an open umbrella or tray well knows how difficult it is to see insects when they are in this folded-up attitude, amid the mass of green and dried buds, leaves and twigs, which are shaken down. And who could detect such an insect as the common beetle, *Byrrhus pilula* lying in this concealment attitude on the rough and rutty soil of a footpath, or many weevils when they fall from bushes or low plants on to the surface of a field or bank. The habit seems to be well worthy of detailed study, and should be taken up by some entomologist in search of a subject of research.—Ed.

It is exceeding difficult to differentiate between the species of this genus, as the different individuals vary to such an extent among themselves that it is almost impossible to separate them in many cases, the specific characters rarely remaining constant. For this reason I have not here described the different species, but an excellent account of this genus has been given by Mr. Cameron.[3]

With regard to the galls to be hereafter described, the inquilines inhabiting them are also given in each case.

Two other genera include insects found as inquilines in oak galls, namely, *Ceroptres* (Hartig) and *Sapholytus* (Foerster). In the former, one species, *Ceroptres arator*, is mentioned by Cameron as present in galls of *Andricus noduli* from Clydesdale, and it is also said to have been reared from *Cynips kollari* galls. The genus *Sapholytus* contains only one British species, *S. connatus* (Htg.) also bred from *Andricus noduli* galls. The characters of these two genera have been given by Mr. Cameron in his work already referred to.

It very often happens that after taking great trouble to breed Cynipidae from a number of different galls one only succeeds in rearing a large proportion of inquilines and parasites. This is very naturally the cause of much disappointment, especially when one is just commencing to collect. Synergidae are very easily mistaken for the gall makers, which they greatly resemble, though as a rule one soon finds plenty of opportunity for ascertaining their exact appearance. True parasites are easily distinguished.

Collecting Galls.

To any one commencing a study of Oak galls who requires to obtain specimens for a collection or for breeding purposes, a great deal of time might be saved, in the case of some species, by first looking through a collection such as that at South Kensington and thus obtaining some of the idea of the exact appearance of the galls before going out to search for them.[4] There are many species which are by no means easy to find even when you *are* aware of their exact appearance; such galls as

3 Peter Cameron's *Monograph of British Phytophagous Hymenoptera*, vol. iv. London Ray Society, 1882-92.

4 It is anticipated that by the Spring of 1903 a typical collection of galls and gall-insects, with drawings and other illustrations, will be placed in the Club's Epping Forest Museum in Queen Elizabeth's Lodge, Chingford, Essex.—Ed.

Andricus albopunctata, *A. malpighii*, *A. collaris* and *A. seminationis* are easily passed over. On the other hand, some galls, such as *Neuroterus baccarum* and *N. tricolor*, being very difficult to preserve, look so different in a collection compared with those growing on the tree that previous examination of specimens in a collection may be quite misleading to the beginner. When searching for galls the casual examination of a branch is not sufficient; a minute examination of buds, leaves, or cuttings, may often result in the finding of several galls even when previous search has failed to reveal their presence. So far as my experience goes, galls are usually scarce in damp woods, and I have frequently found that both species and specimens are more numerous in drier and more exposed situations. One is often able to obtain better results in a short time from searching hedges in a country lane than by spending hours in searching trees in a wood.

Experimental Breeding.

In order to ascertain the life-history of the various species of gall insects, and to investigate the gall formations in the different generations, it is necessary that very close and accurate observations should be made. The act of oviposition is a very important item in this respect. In all cases it is best, and in many instances essential, that in experimental breeding the natural surroundings should be maintained, in order to obtain satisfactory results. For those insects which lay their eggs in the buds, the latter should be well developed; while for those which oviposit on the leaves there should always be tender shoots ready for use. In order to effect this a number of young oak saplings (about 4 or 5 years old) should be obtained. They should then be planted in large pots and placed in some sheltered position where they can obtain the necessary amount of air and light and where they may be subjected to the ordinary temperatures. At the same time the insects must not be allowed to escape or get mixed up in any way. For this purpose I have found the most satisfactory method to be one on the same principle as that made use of, I think, by Dr. Adler. A square box frame-work fitted with a glass top and having the sides covered with gauze to give ready access to the air is placed over each oak sapling. In some cases, in order to facilitate observation, I had gauze on three sides only, the fourth side being fitted with glass. In this way the insects are not allowed

to escape and the necessary investigations can be carried on without difficulty. As the oak does not usually bear fruit until it is about twenty years old (though it depends to a large extent upon soil and climate), this method is obviously useless in the cases of those species which produces galls on the catkins. For these the only way is to experiment upon the full grown tree by covering in certain branches with gauzs. When the act of oviposition is witnessed the bud or leaf should be marked by tying just beneath it round the branch, a piece of cotton or wool. It is necessary with those galls which fall to the ground to mature (such as *Neuroterus lenticularis*) that the natural temperature and amount of moisture should be maintained. As before mentioned, in order to prevent any mistakes, it is desirable that very careful and accurate observations should be made. It is always best when possible that a series of different experiments with the same species should be carried on at the same time. Where one experiment fails another may be succcssful, and time. saved. Even then many disappointments are sure to occurs The result of one apparently successful experiment in breeding should not be taken as proof, but to allow for possible error the observation should be repeated the following year. There is a great deal yet to be found out with regard to alternation of generations among these remarkable insects, and in the case of such species as *Andricus solitarius* the life-history has yet to be worked out.

Preservation of Galls.

With regard to the preservation of galls for a collection. There are many kinds which are very difficult to preserve as they lose their colour and shrink ; and this especially applies in the case of such galls as *Andricus radicis* which contain a great amount of moisture, causing the gall to shrivel and wrinkle after evaporation. I have tried the quick drying method with only partial success, and in many instances by gradual drying and by not exposing the galls to any very high temperature I have caused them to keep their shape and colour fairly well ; but such galls as *Neuroterus tricolor* and *N. baccarum* soon lose both. If kept in spirit the proper form is retained but the colour as a rule gradually vanishes. I find that the best thing to do is to make coloured drawings of the galls when fresh, so that a fair idea of their natural appearance may be had, after the galls themselves have lost their proper shape and colour.

Another method of exhibition, which has been made use of at the British Museum, is the preparation of coloured wax models of the galls and of the plants upon which they grow. As regards oak galls, such as *Trigonaspis crustalis*, both generations are shown in the same case, *Trigonaspis renum* appearing on the leaves and *T. crustalis* from the adventitious buds on the trunk. There is often a tendency to depict "good specimens" by exaggerating the size and number of the galls, and this should be guarded against as giving a wrong impression to anyone who is just starting to collect, who is not always quite certain what to look for. [I have found that a solution of formalin (about 5 per cent. of the 40 per cent. commercial formalin) preserves the *form* of most galls, but any colour dependent upon chlorophyll or its derivatives disappears in the course of time. We are now trying in the museum a method of bleaching with sodium hypochlorite, which discharges *all colour* and produces a semi-transparency, displaying form and structure excellently well, the specimens being "put up" in 90 per cent. alcohol. Of course, as Mr. Lewis says, such preparations should be placed alongside drawings giving the natural colours of the galls.—W. COLE.]

Classification.

Since the discovery by Dr. Adler of the alternating agami and sexal generations among the oak gall-makers, the nomenclature has undergone, a change. The method adopted by Mr. Cameron is the truly scientific one, but these alternating generations present such variations that the generic names used by Dr. Adler,[5] which serve to differentiate more clearly between the agamic and sexual forms, are still adhered to in many cases. I have, therefore, inserted a list showing the differences between the nomenclature of these two authors.

In the case of the three forms, *Andricus fecundatrix*, *Andricus malpighii* and *Dryophanta divisa*, I have found galls of the agamic generation only, and have been unable to find specimens of the corresponding sexual generations, *Andricus pilosus*, *A. nudus* and *Dryophanta verucosus* respectively, so that in this list these latter have been printed in italics. I have inserted them partly because in giving an account of the generation cycle they must necessarily

5 *Alternating Generations. A Biological Study of the Oak Galls and Gall Flies.* By Hermann Adler, M.D., Schleswig. Translated and Edited by Charles R. Straton, F.R.C.S., F.E.S. Oxford 1894.

be mentioned, and partly on account of the fact that as I have found the agamic generation in Epping Forest it is highly probable that the sexual generation is to be found there also, and a description will, therefore, be of use in distinguishing these galls.

In the following account I have kept the generic name of the agamic generation for the sexual generation also. In this respect I have followed Cameron, but in the case of the specific names I have, with a few exceptions, retained those used by Dr. Adler.

(To be continued.)

NOTES—ORIGINAL AND SELECTED.

Destructive Storm in Essex.—In connection with the detailed and exhaustive report given by Mr. William Cole in the ESSEX NATURALIST (vol. x., 112-129) of the great storm of June 24th, 1897, which wrought such havoc in certain but happily restricted districts in Essex, it will be of interest to recall the account given by Mr. Jacob George Strutt, the artist in the *Magazine of Natural History* for 1833 (pp. 103-107) of a similar storm which occurred in Thorndon Park, near Brentwood, on the 12th of October, 1831. The main part of the narrative there reprinted was taken from a Chelmsford paper, and it was accompanied by a woodcut of a scene from the midst of the havoc drawn upon wood by Mr. Strutt, which is here reproduced. I quote some paragraphs from the narrative:—"On the evening of Wednesday, the 12th inst. (October, 1831), a destructive hurricane ravaged a considerable portion of the park of Thorndon Hall, the seat of Lord Petre, near Brentwood. The blast came on about eight o'clock, and in less than four minutes the work of havoc was complete. It appears that the wind came from the south-west, and entered the park near the Lion's Lodge, where it threw down a small portion of the paling. It then traversed the park in a varying sweep of about 150 yards' breadth. It is difficult to form any idea of the manner in which it took its course, as it has made many singular selections of spots and single trees. The line of desolation is not an uninterrupted one; in many places, a large breadth of trees has escaped unhurt, while others, apparently sheltered by them, have been shivered or torn up by the roots. In some groups of three or four trees, one of the least exposed has shared in the ruin, while its more exposed neighbours have not lost a leaf. On entering the park at the Lion's Lodge, on the west or Warley side, the eye is immediately attracted to the right hand by several oaks, 60 feet long, which have been torn up by the roots and to which are adhering masses of earth, 14 feet in length, and from three to four feet in thickness . . . . . The stems of many trees are off within a few feet of the earth, some at the height of two or three feet, others at a greater height; and one elm has been severed at about 20 feet from the ground, 15 feet of the stump having half its body torn away

In one place, about 100 yards from this spot, the destruction has been tremendous. In a circle of nearly 40 yards diameter. whole trunks, huge limbs and branches, with immense masses of earth, lie on the ground in wild confusion, mingled in such a manner that it is impossible to count the number of trees destroyed. It appears as if a battery of heavy artillery had been directed against a great mass of timber which had crowded that part of the park." The narrator gives numerous details of havoc in various parts of the grounds, which attest the extraordinary force and capricious character of the storm, and remarked that the "blast has not taken a direct and lofty course, sweeping all before it; and we can form no other idea of it, than that it moved with infinite velocity, undulating like the rushing of a mighty sea; sometimes passing over the spires of the gigantic oaks and elms, and then

Effects of Storm in Thorndon Park, October 12th, 1841.

striking the earth, rebounding and insinuating itself beneath some trees, and levelling others by its force operating near the earth." . . . . "We understand that (the storm) did some little injury at the distance of a mile to the east of the park. It was also severely felt at Upminster, in the west. before it commenced its ravages on Lord Petre's demesne. We have endeavoured to compute the extent of mischief done in the park, but find it impossible, from the confused state in which the shattered and fallen timber at present lies; but we believe there cannot be less than 300 trees torn up, or so much shattered as to render it necessary that their remains should be felled. As to the partially injured timber, it is too extensive to be enumerated. This park, during the war, furnished some of the finest naval timber that could be procured in the kingdom, and it still presents a large number of equally valuable trees. . . . It is a little singular that the noise occasioned

by the destruction was heard in the mansion, but was supposed to be thunder, and the real cause was not ascertained till next morning. The hurricane was immediately succeeded by a tremendous fall of rain." This graphic description of the Thorndon Park Storm recalls in many particulars our Essex experience particularly in the isolated character of its destructive effects.—WILFRED MARK WEBB, F.L.S., Odstock, Hanwell.

The Soils and Sub-soils of Norfolk.—A paper with the above title, by Mr. H. B. Woodward, F.R.S., F G.S., of the Geological Survey, was read before the Norfolk and Norwich Naturalists' Society on March 25th, 1902, and is published in Vol. VII. of their *Transactions*, pp. 401-414. As the counties of Norfolk, Suffolk and Essex have a specially strong resemblance to each other in geological structure, it seems desirable to draw the attention of the Essex Field Club to Mr. Woodward's remarks. He gives an account of the various essays and maps on the soils of Norfolk, from the *Rural Economy of Norfolk*, by William Marshall, published in 1787, to the work of Nathaniel Kent (1796), Arthur Young (1804), R.N. Bacon (1844), Joshua Trimmer (1847), Searles V. Wood, junior and Mr. F. W. Harmer somewhat later, and lastly that of the Geological Survey. The distribution of the various soils and subsoils of Norfolk is then noted. Mr. Woodward adds that while there is a general correspondence between the subsoils and soils, "yet there is an infinite variety in the soils such as cannot be fully indicated on a geological map, and can only be inferred from a knowledge of the subsoils." He inclines therefore to think that:—"A detailed sub-soil map on a scale of 6 inches to a mile, carefully and judiciously surveyed, should serve as a basis for special investigations of soils. On it the general characters of soils should be indicated, and where there is much landslipped material or considerable downwashes of the sub-soils these should be marked. Sometimes downwashes of gravel from the uplands are of sufficient importance to have shallow gravel-pits opened in them, or buildings may be erected on them—and yet in ordinary geological maps, which profess to show the Drifts, this debris from higher grounds, or 'run of the hill' has been omitted when it is of sufficient importance to influence the surface features. This is, undoubtedly, a defect."

Of course on maps 6 in. to the mile much can be indicated useful to the agriculturist, the builder and others, which could not be shown on maps of smaller scale; much also which would be felt to add obscurity rather than information to a map one-inch to the mile. Readers of the ESSEX NATURALIST may be interested in learning that the Geological Survey of Essex on the six-inch scale is now begun.—T. V. H.

[*Several Reports and Notes are held over until the next volume.*]

End of Volume XII.

An interesting record of the Club's work for 21 years is given by Prof. Meldola in his pamphlet "The Coming of Age of the Essex Field Club" (price 1s., *post free*).

ORDINARY (SCIENTIFIC) MEETINGS are held at frequent intervals for the reading of papers and the exhibition of specimens, etc., and FIELD MEETINGS are arranged during the summer months, and held in various parts of the County under the guidance of experienced Naturalists, Geologists and Archæologists.

Considerable efforts have been made to catalogue the FAUNA and FLORA of the County, and it is wished to extend this work as funds and opportunities will permit, particularly in the direction of a systematic Exploration of MARINE and ESTUARINE forms of life by DREDGING. etc., and their preparation and preservation in the Essex Museum, for future reference and study.

Although bearing a county title, *the Club offers exceptional advantages to Metropolitan residents.* Many parts of Essex are but little known, although of the greatest interest to the naturalist, geologist and antiquary, and the Museums and Libraries at Stratford (at which place a large proportion of the "Winter Meetings" are held) and Chingford, bring the Club into close touch with London naturalists.

Very considerable material has been accumulated towards a LOCAL and EDUCATIONAL MUSEUM, which is established in a handsome building at Stratford (by the generosity of Mr. Passmore Edwards, and in conjunction with the Corporation of West Ham) to form a home for County collections and specimens, where they may be consulted by all interested in Essex. A BRANCH MUSEUM to illustrate the Natural History and Archæology of EPPING FOREST has been established (under the sanction of the Corporation of London) in QUEEN ELIZABETH'S LODGE, CHINGFORD, which has proved very attractive to thousands of visitors to the Forest. Greatly increased space for the Museum is now accorded at the Lodge, the Corporation of London having spent about £1,200 in the restoration and adaptation of the building. In conseqnence the Museum is in process of re-arrangement, which will be completed, it is hoped, in the summer of 1903.

The Club already possesses a good nucleus of a Local and Scientific LIBRARY, which has been obtained by donations, exchanges and purchase.

The *Minimum* SUBSCRIPTION is Fifteen Shillings per annum, payable upon election, and afterwards on the 1st January in each year. The usual entrance fee is at present in abeyance. The LIFE COMPOSITION is £10 10s. in one payment. *Members can purchase the publications of the Club at a Discount of 25 per cent. from the published prices.*

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N.B.—All communications of a financial nature, SUBSCRIPTIONS, DONATIONS to the MUSEUM and LIBRARY FUND, etc., should be sent to the *Treasurer*, DAVID HOWARD, Esq., Devon House, Buckhurst Hill, Essex; communications relating to the LIBRARY, and Donations of Books and Pamphlets, and SPECIMENS FOR THE MUSEUM should be sent to the Head-quarters, Essex Museum, Romford Road, Stratford, Essex.

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